The

HANDBOOK

OF THE

Douglas

MOTOR CYCLE

2¾ H.P.

THE

Douglas

HANDBOOK

Dealing with the

$2\frac{3}{4}$ h.p. Lightweight Motor Cycle,

and its predecessors.

PRICE 1/6 *NETT.*

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FOREWORD.

MANY are the appreciations which have come to us for our last edition of the "Handbook," but our stocks having become exhausted and our new models having much that is new to describe and advise upon, we have prepared, at considerable expense, this new edition for 1925, and we trust that its reception will be as hearty as that accorded to our previous issues.

It has been our endeavour to include, wherever possible, as well as the usual instructions, hints, and tips, etc., a descriptive article explaining explicitly and simply the actual operations, so that readers, however ignorant of motor matters, may become fairly conversant with motors in general after perusing these pages. To those who are about to receive initiation to the pleasures of Motor Cycling on a Douglas, we offer the Handbook, to assist them in obtaining the same satisfaction from the wonderful little machine that some eighty-five or ninety thousand Douglas riders are receiving to-day. To those Motor Cyclists with years of experience we offer no apology in placing this Handbook for their perusal, for we feel sure that they will be no less interested in these pages than the novice; there is much herein that is the outcome of our nineteen years' experience of an original type of engine, the Douglas Twin Opposed.

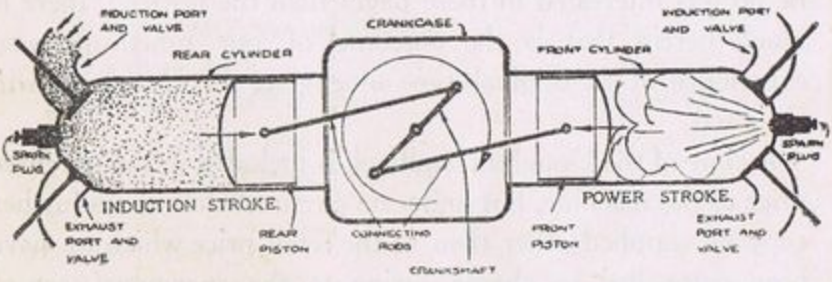
A copy of the Douglas Handbook is included in the purchase price of the machine, but under no circumstances can a further copy be supplied other than at the retail price which we have been compelled to charge owing to the enormous cost of production and the large demand by all classes of Motor Cyclists. However, we have made this as reasonable as circumstances would permit, and in fixing the retail price at 1/6 (one shilling and sixpence), we hope to bring this useful work within the reach of all those interested.

PETROL MOTORS IN GENERAL.

In principle, the petrol motor is identical with the stationary gas engine. Each has the same working parts; the cylinder into which the explosive mixture of gas and air is drawn, compressed, and then exploded by an electric spark, the burnt gases being finally exhausted into the atmosphere. The power is transmitted from the piston by a connecting rod driving on a crank, which is an integral part of the main shaft. On this latter is mounted a flywheel, which, by its momentum, keeps the engine moving smoothly during the idle strokes of the piston, for in a four-stroke single cylinder engine there is only one power stroke out of every four.

The small engines used for motorcycles are air-cooled, that is to say, the onrush of the cold air maintains them at a temperature not too high for efficient lubrication. To regulate the admission of gas into the cylinder, and to enable the burnt gases to be ejected, valves worked from the crank-shaft are provided. These valves are fitted in the combustion head, and open inwards.

ILLUSTRATION 1



FIRST STROKE.

REAR CYLINDER. *INDUCTION STROKE.*

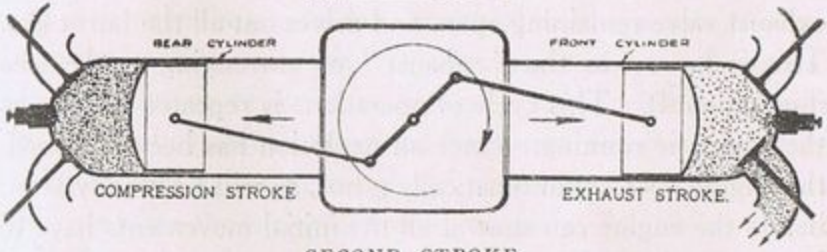
Inlet valve opening, piston descending and sucking into the cylinder combustive mixture of petrol and air. Exhaust valve closed during the stroke.

FRONT CYLINDER. *POWER STROKE.*

Piston forced down by expansion of gases which are ignited by a spark occurring at the points of the sparking plug when both valves are closed and the combustion chamber is gas-tight.

This is what happens when the engine is working :—The inlet valve opens just as the piston is about to descend. The piston descends and creates a vacuum. Gas rushes in and fills this vacuum. This is called the "induction" stroke (see illustration 1). The piston begins to ascend and the inlet valve closes. The piston continues to ascend and compresses

ILLUSTRATION 2.



SECOND STROKE

REAR CYLINDER. *COMPRESSION STROKE.*

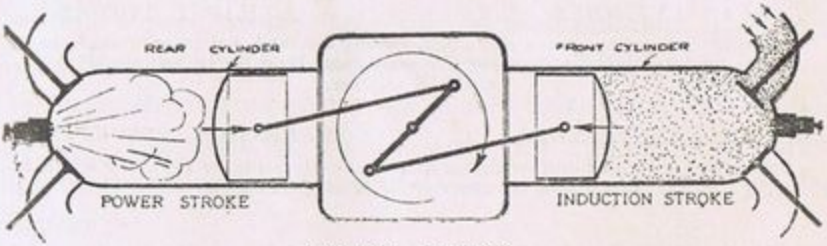
Both valves are closed and the piston ascends compressing the explosive mixture into a confined space in the head of the cylinder.

FRONT CYLINDER. *EXHAUST STROKE.*

Exhaust valve open, piston ascending, forcing out the burned gases through the exhaust into the atmosphere to make room for a further supply of explosive mixture.

the gas. That is the "compression" stroke (see illustration 2). Just as the piston is about to begin its second journey downward, an electric spark occurs within the cylinder. This

ILLUSTRATION 3.



THIRD STROKE.

REAR CYLINDER. *POWER STROKE.*

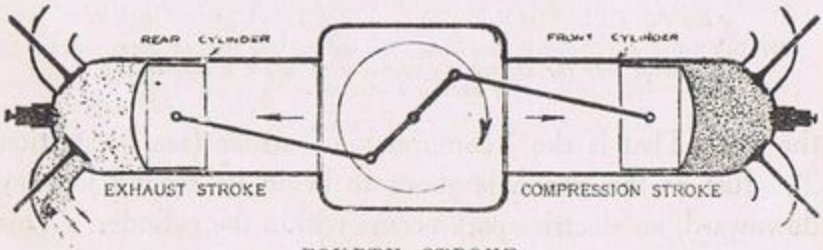
Piston forced down by expansion of gases, which are ignited by a spark occurring at the points of the sparking plug when both valves are closed and when the combustion chamber is gas-tight.

FRONT CYLINDER. *INDUCTION STROKE.*

Inlet valve opening, piston descending and sucking into the cylinder explosive mixture of petrol and air. Exhaust valve closed during the stroke.

sets fire to the compressed gas and causes it to expand violently, thrusting down the piston with great force. That is the "power" stroke (see illustration 3). Just before the "power" stroke is completed, the exhaust valve opens and the burnt gas escapes from the cylinder at a high pressure. It is the sound of this burnt gas escaping, or "exhausting," that gives the petrol motor its characteristic sound. The actual explosions are never heard. The piston now ascends once more, the exhaust valve remaining open, and drives out all the burnt gas. This is known as the "exhaust" or scavenging stroke (see illustration 4). This cycle of operations is repeated as long as the engine is running. Once an explosion has been obtained, the engine goes on automatically; but, as will be readily seen, before the engine can start at all the initial movements have to be conveyed to it from an outside source.

ILLUSTRATION 4.



FOURTH STROKE

REAR CYLINDER. *EXHAUST STROKE.*

Exhaust valve open, piston ascending, forcing out the burnt gases through the exhaust into the atmosphere to make room for a further supply of explosive mixture.

FRONT CYLINDER. *COMPRESSION STROKE.*

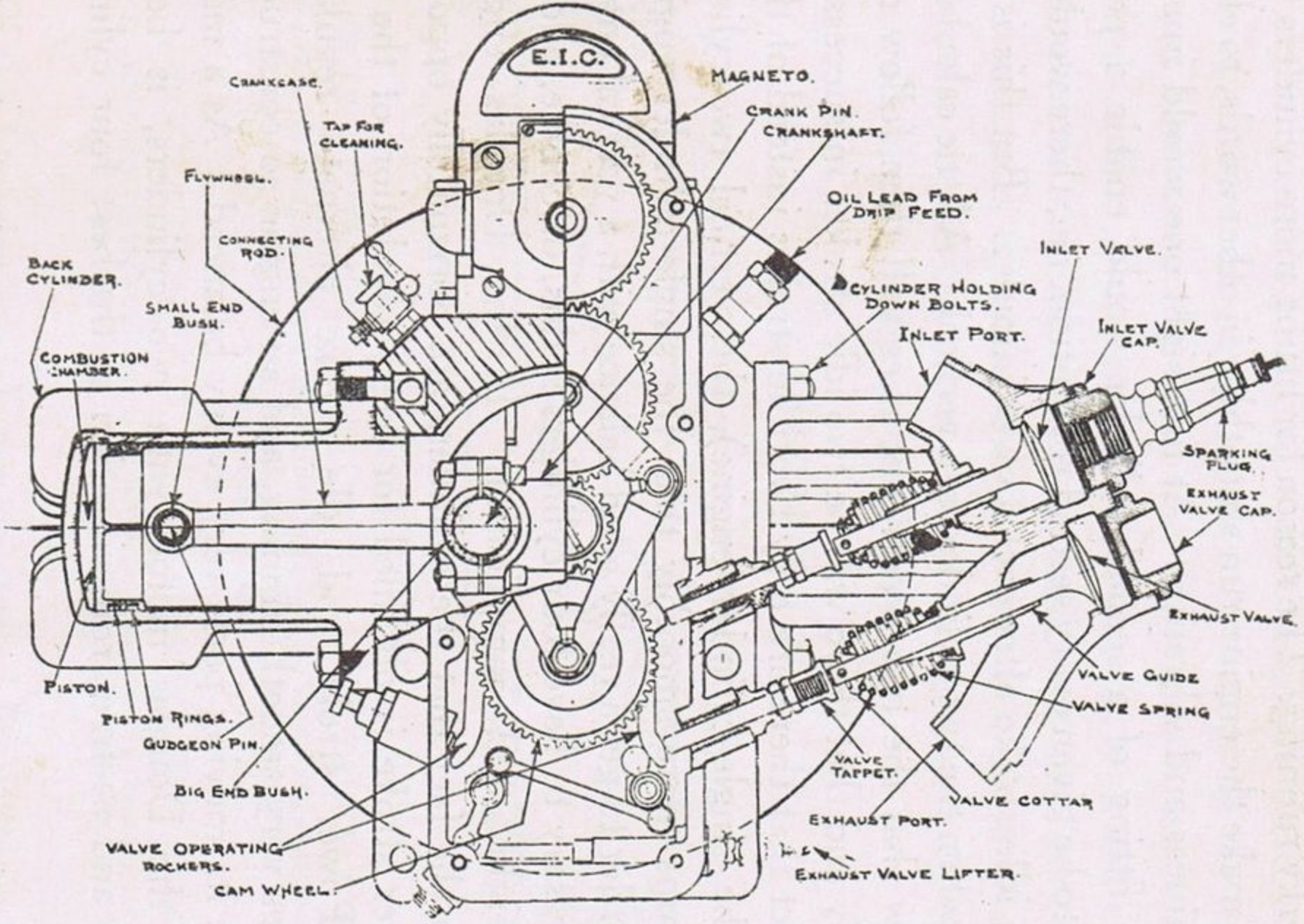
Both valves are closed and the piston ascends, compressing the explosive mixture into a confined space in the head of the cylinder.

All the Douglas models can be started by walking alongside the machine; but models S.W. and C.W. can also be started by downward pressure of a pedal while the machine is stationary. This produces a movement of the pistons similar to that obtained by turning round the starting-handle of a car.

THE DOUGLAS TWIN OPPOSED ENGINE.

This motor has two cylinders. When an engine has only one cylinder, as has just been explained, there are three idle strokes of the piston for every power stroke. This, of course, means jerky running. The reason for fitting more cylinders than one is to make the engine run smoothly; in other words, to eliminate jerkiness and vibration. At first sight one would imagine that the fitting of a second cylinder would enable a power impulse to be given every second revolution, *i.e.*, there would be only one idle stroke after each power impulse. But this is not the case when the two cylinders are vertical. A little calculation will show that the two power impulses will then follow consecutively and that there will be two idle strokes in succession. In respect that there are only two idle strokes instead of three (as in the single-cylinder engine), the vertical two-cylinder engine runs more smoothly than the single-cylinder engine; but, in order to get a really good balance with a vertical engine, it is necessary to have four cylinders; this, of course, adds to cost, weight, and complication. In the Douglas engine, owing to the fact that the cylinders are horizontally opposed, one power stroke is obtained for every revolution of the flywheel. Power stroke and idle stroke alternate regularly. This gives very smooth running, and an engine so constructed can have its moving parts very evenly balanced. As a matter of fact, the Douglas motor, with two cylinders, is better balanced and as free from vibration as the best four cylinder motors.

On page 9 is a simple diagram showing the advantage gained by the Douglas twin opposed engine, as far as power impulses are concerned, over all other designs of engines. In each type of engine dealt with, four complete revolutions of the crankshaft have been taken into consideration.



A Half Section through the 2¾ Douglas Engine.

THE DOUGLAS ENGINE.

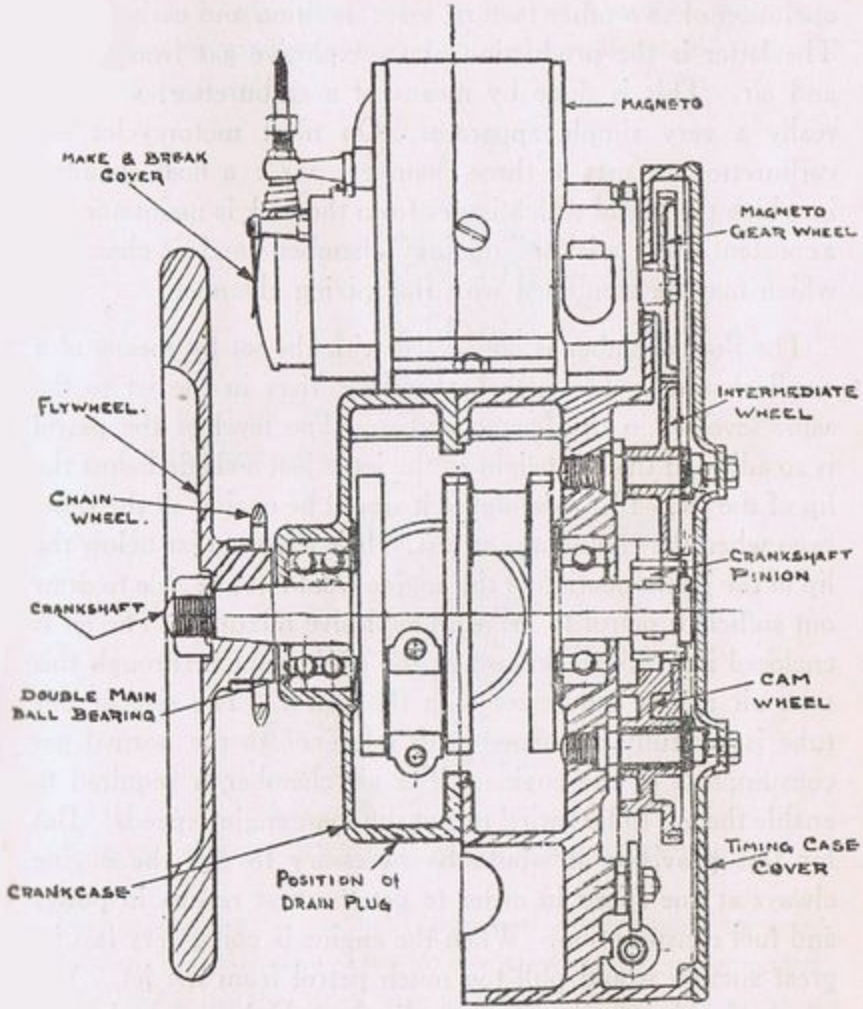
P——————P——————P——————P——————P

A SINGLE CYLINDER ENGINE.

P——————————————P——————————————P

A "V" TWIN ENGINE.

P——————P——————P——————P——————P



A Section through the 2½ Douglas Engine.

It will be noticed that the power impulses of the Douglas, represented by "P" in the diagram, are very regular and occur at every 360 degrees of the crankshaft. With the "V" type twin-cylinder engine the power impulses are very irregular, occurring at 315 and 405 degrees.

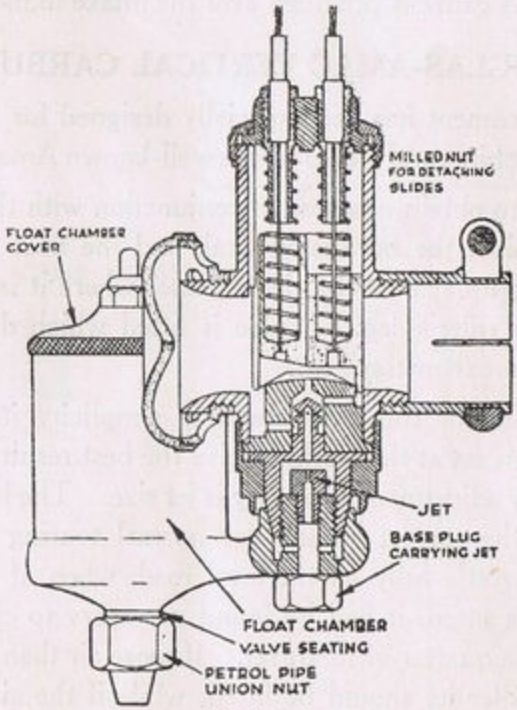
CARBURATION.

The action of the engine is dependent on the efficient co-operation of two other factors, viz.: ignition and carburation. The latter is the production of an explosive gas from petrol and air. This is done by means of a carburettor, which is really a very simple apparatus. On most motorcycles the carburettor consists of three chambers, viz.: a float chamber in which the petrol which issues from the tank is maintained at a constant level; a jet or "mixing" chamber; and air-chamber, which may be combined with the mixing chamber.

The float chamber is connected with the jet by means of a small channel. The petrol, therefore, rises in the jet to the same level as in the float chamber. The level of the petrol is so adjusted that its height in the jet is just a shade below the lip of the jet. If it rose higher it would be oozing all the time, even when the engine was at rest. If it were too far below the lip of the jet the suction of the engine would not be able to draw out sufficient petrol to make an explosive mixture. The jet is enclosed in a funnel, known as the choke tube; through this tube air passes and mixes with the petrol. The size of this tube is carefully calculated with reference to the normal gas consumption of the engine. The air chamber is required to enable the gas to be varied to suit different engine speeds. But for this provision it would be necessary to run the engine always at one speed in order to get the best results in power and fuel consumption. When the engine is going very fast its great suction would pull too much petrol from the jet. The effect of this suction is neutralised at high speeds by the

admission of more air. The carburettor does not begin to work until the engine fly-wheel has been rotated. The motive power of the carburettor is the suction created by the vacuum in the cylinder on the induction stroke.

It is usual for the jet chamber and extra-chamber to have piston valves which are actuated from the handle-bar of the motor cycle. The piston valve in the jet chamber regulates the amount of gas given to the engine. It is usually termed the "throttle" valve.



THE 1920-21 DOUGLAS-AMAC CARBURETTOR.

This carburettor is specially designed for Douglas engines, It is simplicity itself. The float chamber has an inverted needle lifted by the float, which maintains the petrol at a constant and proper level. The jet, a single orifice, is carried in a base plug beneath the mixing chamber; above this is the

sprayer, a series of holes drilled in the raised centre of the "floor" of the mixing chamber. Petrol is sucked from these in a fine spray directly in the path of the inrushing "extra" air, and the mixture is carried on into the engine via the induction pipe. In old types of this carburettor the vaporising of the petrol is further assisted by the heat applied from a bypass of the exhaust to a jacket surrounding the mixing chamber. Control is effected by two circular slides, one within the other, operated by Bowden cable from the handlebar levers, which decrease or increase the effective size of the throttle and air inlets. A gauze is provided over the intake to filter the air.

THE DOUGLAS-AMAC VERTICAL CARBURETTOR

This instrument has been specially designed for the 2¾ h.p. Douglas machine, and works on the well-known Amac principle.

In order to obtain neatness in conjunction with the standard induction pipe, the bore is vertical, and the float chamber is placed close up against the timing case, where it is out of the way of the rider's leg. A pipe is fitted which draws warm air from the exhaust system.

The tuning of this instrument is simplicity itself as the carburettor is set at the works to give the best results all round, and the only adjustment necessary is jet size. The best method of finding the correct jet size for normal touring work is to open the throttle fully on the level road, when, if the correct size of jet is fitted, it will be found necessary to close the air lever about a quarter of its travel. If more air than this can be given a smaller jet should be fitted, while if the air has to be nearly closed, the jet is too small. Too small a jet tends to over-heat the engine, while too large a jet has an adverse effect upon petrol consumption.

The above tests should be made when the engine is warm.

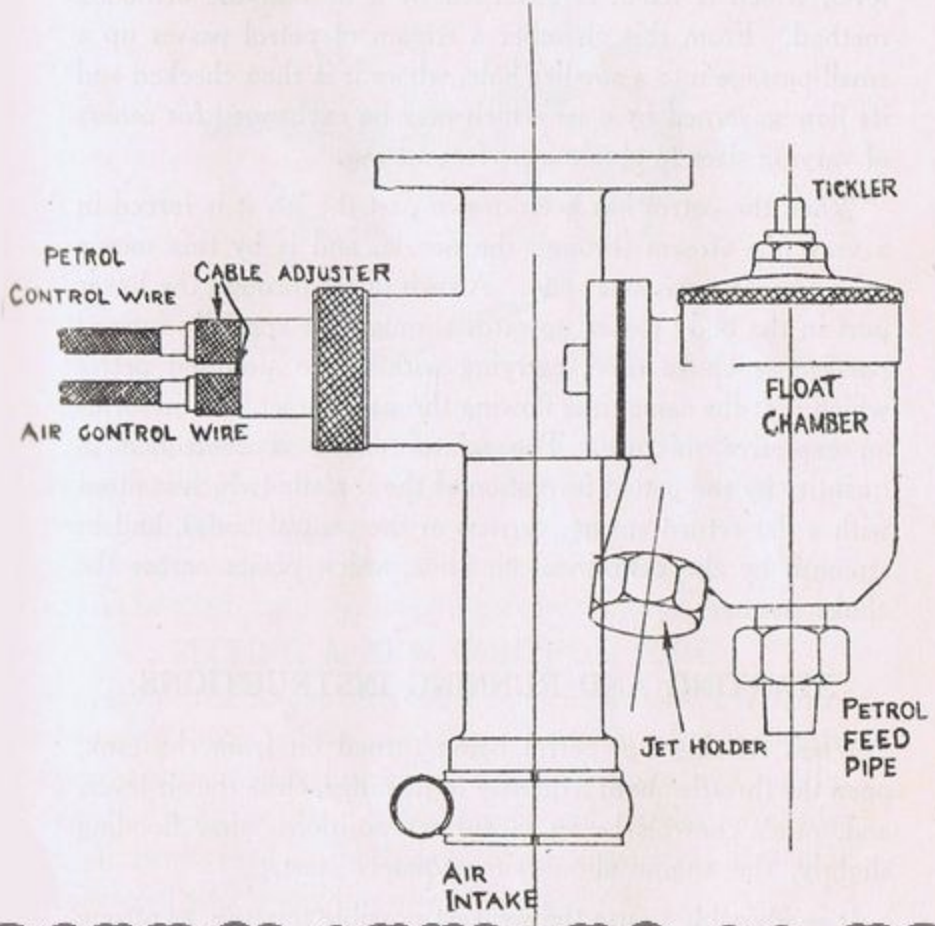
The jet can be inspected by unscrewing the large plug at the side of the float chamber, when the jet will be found screwed

into the top of this plug. The size of the jet is stamped on the side of it.

The air lever should be closed for slow running, and opened fully for normal touring work, while it should be slightly closed for hills and when full throttle is required.

An important point when re-assembling the engine after over-haul is to see that there are no air leaks between the carburettor and the engine, particular attention being paid to the induction pipe joints.

THE DOUGLAS-AMAC VERTICAL CARBURETTOR.



THE DOUGLAS AUTOMATIC CARBURETTOR.

Points upon which this Carburettor is claimed to be especially efficient :—

Slow Running, Low Petrol Consumption, Easy Starting, Quick Acceleration.

ACTION OF THE CARBURETTOR.

Liquid petrol is allowed to enter the float chamber, and its level, which is fixed, is governed by a float in the orthodox method. From this chamber a stream of petrol passes up a small passage into a smaller hole, where it is then checked and its flow governed by a jet which may be exchanged for others of varying sizes to obtain a perfect setting.

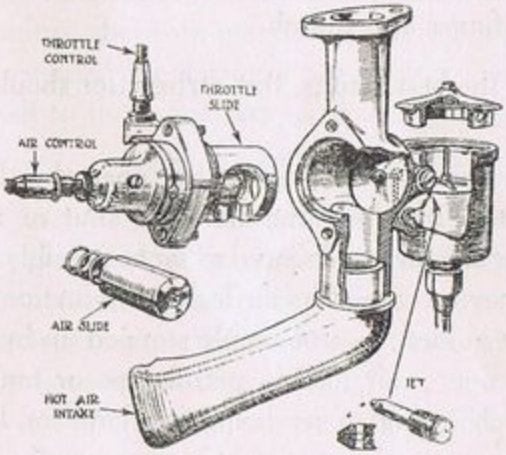
When the petrol has been drawn past the jet, it is forced in a very fine stream through the nozzle, and is by this means split up into a gaseous state. A rush of air through the lower port in the body passes upwards through the specially formed passage or choke tube, carrying with it the atomised petrol which is at the same time flowing through the jet, and so forms an explosive mixture. The mixture itself is controlled in quantity by the patent formation of the throttle (which is fitted with a flat return spring, carried in the central body), and in strength by the cylindrical air slide which passes across the choke passage.

STARTING AND RUNNING INSTRUCTIONS.

When starting up, petrol being turned on from the tank, open the throttle about a quarter of its range, close the air lever, and, other controls being in correct positions, after flooding slightly, the engine should immediately start.

It is advisable to use the weakest possible mixture, as strong mixtures do not necessarily give greatest power and speed,

and the spare jets may be experimented with to find the best setting. It will be found that the slot in the end of the jet body will permit the edge of a coin to be inserted therein, so that the changing over to the spare size jet from the existing one is a very simple operation—without the use of screwdriver or spanner. It should be noted that the taper end of the jet makes a good joint on its seating, or petrol will be drawn past with bad running results. Whether this seating is making a proper joint may be ascertained by inspection of the end of the jet, where a narrow bright ring on the taper should be visible.



A particular note should be taken to ensure that all joints of unions are absolutely air-tight, otherwise good slow running cannot be expected.

In cold weather the hot-air extension pipe to the air inlet should be used, but in summer it may be removed if necessary.

FITTING A NEW CONTROL WIRE.

Every provision has been made to facilitate the replacement of a control wire. This now takes a matter of a few moments. Spare wires are cut and supplied ready made up to dead lengths, complete with washers, outer casings and nipples—a similar nipple being used on both ends of both wires, so that it is immaterial which way the wire is fitted.

By removing the top cap of the control lever body it will be seen that the inside rotating member is provided with a slot at one end of its segment over which the nipple and wire may be hitched, and the nipple will pass through the hole in the body of the control without being unsoldered from the wire.

The whole lever is very simple, and a glance at the interior will make these operations clear.

The float-chamber cover is of the clip-on type not screwed—it will be found that it can easily be worked upward with slight pressure by finger and thumb.

To obtain the best results, this carburettor should be treated as follows :—

Starting.—For easy starting, do not open the throttle more than a quarter, and keep the air valve shut or nearly shut. Ignition lever should be advanced as far as possible. Difficulty in starting may be caused by air leaks at induction pipe joints, or inlet valve guides ; petrol supply stopped up by dirt in pipe or petrol strainer ; air lock in petrol pipe or tank ; mixture being too rich owing to jet being too large or to flooding ; mixture too poor owing to jet being too small ; carburettor not vertical, making petrol level too high or too low ; throttle and air inlets too far open.

Driving.—The jet should not be so large that the engine will take full air and full throttle. It must be remembered that the air valve acts as a variable choke and that the air passage at the sprayer, when both valves are fully opened, is considerably larger than the inlet pipe. This is done so that plenty of air can be obtained even with a racing setting without having to drill and cut the spraying chamber. If the air-lever can be opened two-thirds to three-quarters when going full out, this should show that the setting is about right. If less, jet is too small ; if more, jet is too large. This does not apply to setting for racing or hill climbing competitions. Now, as the

action of the throttle valve supplements that of the air valve to a certain extent, it will be found that for all ordinary variations in speed it is not necessary to alter the positions of the air lever. Of course, when climbing a steep hill the air lever should be closed down, and also for very slow running. Although it will be found that the machine will run with the throttle nearly closed and the air full open, owing to the supplementary action of the two valves, this is not an indication of a too large nozzle or that the carburettor does not give enough air, but it is a natural consequence of its semi-automatic action. Neglecting the *finer* points, there are practically only three positions of the air-lever :—closed for starting ; a quarter to half-way open for traffic ; half to three-quarters for country roads.

AMAC JET SIZES.

Size of Jet.—Approximate sizes of jet to suit the Douglas engine are given below, as an indication of what ought to be fitted. Of course, engines of the same capacity do not always take the same size jet. We have found, as a rule. the tendency of the rider is to fit too large a jet.

1914-15 and -16 models require a 27 jet with two gauzes on the air intake and a 28 jet with one gauze.

In very hilly country a jet one or perhaps two numbers larger may be used, but a little time spent in experimenting will be well returned in results.

Imperfect Running.—Either a too rich or a too poor mixture will cause mis-firing at slow engine speed, or stop engine altogether. If the mixture is too rich, black smoke may issue from the silencer. If very poor, "popping back" will take place in the carburettor.

Too large a jet and flooding of the carburettor will give too rich a mixture.

Air leakage at valve guides or inlet pipe joints ; bad petrol supply ; dirt or water in petrol ; low level, owing to carburettor not being fitted vertical ; all cause a poor mixture.

Flooding.—Dirt on needle seating. Worn needle valve seating. Petrol gauze filter being distorted, preventing proper working of needle valve. Bent needle valve. Split pin not being fixed under collar on needle valve. Punctured float. Air vent in tickler being blocked.

Remember in an Amac Carburettor the level of petrol is set just below top of sprayer in mixture chamber and not to top of jet. The level is carefully set and tested at the works before carburettor is sent out. In most cases if the carburettor floods, especially on new machines, it is due to dirt on needle valve seating. This may, as a rule, be cured by twisting needle valve between fingers, pulling up at the same time. Machines ought not to be left standing for long periods without turning off petrol cock.

Heavy Petrol Consumption.—This is generally caused through too rich a mixture, either too large a jet being fitted or through flooding. It might also be caused through the air gauzes gradually getting stopped up with dust, or the two air gauzes being pressed together. Undue vibration is another reason.

HINTS ON RUNNING AND TUNING OF A BINKS TWO-JET CARBURETTOR.

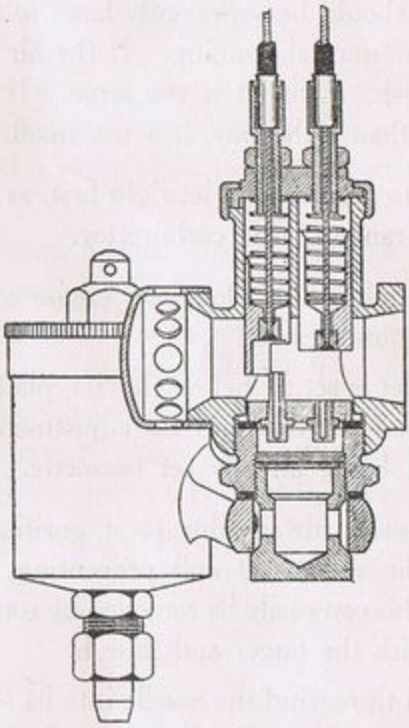
This instrument, designed specially for the "Douglas" engine, works on the two-jet principle, and is practically automatic in action owing to the compensating action of the two jets, one with the other.

The main jet is situated in the centre of the airway—and the pilot jet is directly underneath the sliding piston throttle.

The pilot jet is much smaller in size than the main jet—its purpose is to provide a good mixture for starting and slow running, and the main jet comes into action when more speed and power is required.

When the throttle is in the nearly closed position a very strong suction is placed upon the pilot jet, providing the engine with a suitable slow running mixture, the main jet being entirely out of action owing to there being no suction on it.

As the throttle is opened, however, the suction is gradually placed upon the main jet, which commences to feed the engine,



but as the throttle is receding from the pilot jet, the suction on this decreases and this keeps the mixture automatic.

The air lever is used solely for controlling the strength of the mixture to suit varying gradients and atmospheric conditions. For all ordinary running it should be left about $\frac{3}{4}$ open.

To start up from cold, close the air lever and open the throttle about $\frac{1}{8}$ and slightly flood the carburettor. The engine should start first or second kick. Immediately open up the air to $\frac{3}{4}$ wide and open up the throttle as required.

Hints on Tuning.

Start with the pilot jet—this should be the smallest size on which the engine will run steadily with the air $\frac{3}{4}$ open. If the engine " hunts " the pilot jet is too large. On the other hand, if it will only run slowly with the air lever closed, it shows the jet is too small.

The main jet should be sufficiently large to allow of the air being $\frac{3}{4}$ open for normal running. If the air can be opened absolutely wide the main jet is too large. If it requires the air closed more than $\frac{1}{4}$ the way, it is too small.

It is essential to get the pilot jet right first, as this is in action over the whole range of the carburettor.

The correct jets for the " Douglas " engine are Nos. 1 and 6 for the best all-round results.

The petrol level is set $\frac{1}{4}''$ below the jet plate and every instrument is tested for this and no adjustments in the level are necessary, it being already set correctly.

Flooding is nearly always due to impurities in the petrol getting on to the valve seat and preventing the valve from shutting off. This can easily be removed by rotating the needle once or twice with the finger and thumb.

Never attempt to regrind the needle into its seat with emery. Other less likely causes of flooding are : Broken spring clip, bent needle or punctured float.

It is advisable occasionally to clean out the filters, one of which is situated under the needle valve and another directly underneath the jets.

Great care should be taken to see that there is no dirt in the carburettor when putting it together after dismantling and provided the filter under the jets is not damaged, a choked jet is practically an impossibility.

Irregular slow running is nearly always caused through air leaks, either in the inlet pipe joints or through worn inlet valve stems. This can be partially overcome by fitting a slightly larger pilot jet, but for the best results all air leaks must be eliminated. Smaller jets are required when using benzole mixtures.

IGNITION.

In the earlier days of motor cycles ignition by coil and accumulator being very troublesome, the introduction of the magneto proved a great boon to motor cyclists.

The high-tension magneto used on motor cycles is a combination of a specialised type of dynamo with an induction coil. As in a dynamo, the current is obtained by the rotation of an armature in a magnetic field. The armature is wound in such a manner that it takes the place of an induction coil. By means of a contact-breaker attached to the armature spindle, the high-tension current is tapped at the precise moment when the spark is wanted for purposes of ignition. For further details of new magnetos and their care see the makers handbook, while full particulars of the older types will be found on pages 80 to 83.

It should be kept in mind that, though nominally the magneto allows a certain amount of latitude in regard to the timing of the spark, in reality there is just one position at which the maximum intensity of spark is secured. If the timing lever is behind or in advance of this position, the spark will be feebler and the explosions less powerful. In the Douglas motor the magneto is so timed that the spark is at its maximum efficiency when the lever is fully advanced. Consequently this position will be found best for all-round work, and it will rarely be necessary to retard the spark unless on very steep hills.

HOUSING THE UNIT.

Before the petrol motor can be of any practical value it must be fitted up in such a way that it can be fed with petrol and lubricant, and be able to transmit its power to the vehicle which it is meant to propel. This is the problem which every designer of a motor bicycle has had to solve, and a very difficult problem it has proved. Generally speaking, the tank lies above the engine and between the legs of the rider. It has two compartments, one for petrol and one for lubrication. Two pipes run from the tank—a petrol pipe to the carburettor, and an oil pipe to the engine. The petrol is gravity-fed to the carburettor.

TRANSMISSION OF POWER, ETC.

There are three recognised methods of transmitting the power of the engine to the road wheel. The combined chain and belt, the all chain, and the shaft. The direct belt drive from the engine pulley is fast disappearing from motor cycle practice. Whilst there is much to be said for all these three recognised methods of transmission, the chain and belt type is undoubtedly the simplest.

It has the advantage of enabling a large belt pulley to be used on the countershaft, thus obviating the trouble and wear occasioned on bending a belt round a small diameter pulley. This was the chief cause of belt troubles on earlier machines with direct drive. A good make of belt should last 4,000 to 6,000 miles in combination with a chain, but 2,000 used to be considered good for a direct belt drive.

Accordingly, the form of transmission adopted on this Douglas motor cycle is a combined chain and belt drive, which has, on the whole, proved to be the most efficient and most economical yet designed. The soft, yet tenacious, pull of the belt directly prolongs the life of the tyres and of the engine.

and it undoubtedly assists in minimising the effect of road shocks to the rider. Moreover, belt slip is almost unknown with the large pulley fitted to the Douglas motor cycle.

CW/25 is all chain driven, used in conjunction with the flywheel clutch and highly efficient shock absorbers on the gear box. The harshness usually associated with the all-chain drive is entirely eliminated in this way.

This model will appeal to the motor cyclist who prefers the positive drive.

PREPARING TO START.

Having jacked up the machine on the rear stand, the tanks should be filled—the front part with oil and the main tank with petrol. In filling the petrol tank care should be taken to pour the petrol through a funnel containing a fine gauze strainer. See that the petrol tap is open ; *i.e.*, when the lever is pointing downwards.

When the machine is received from the makers the oil has been drawn out of the crank-case, and before starting three pumps full should be forced into the crank-case by means of the pump. In a high-speed engine, such as this, particular care should be taken to use always an oil of good repute intended for air-cooled motors. Messrs. Wakefields, makers of "Castrol," after exhaustive tests with our engines, have blended a special oil—"X.L."—which gives excellent results, and is recommended for new engines and bearings. If the Douglas engine has been adequately lubricated with good oils, the piston will not gum up ; no provision is made for injection in the latest models.

ABOUT LUBRICATION.

It is desirable at this stage to say something about the semi-automatic lubricator which is fitted to all Douglas models. Primarily, this consists of a pump with a non-return valve

between it and the oil tank. In the barrel of the pump there is a spring which presses down the plunger. Above the pump and resting on the top of the tank is a sight feed, the function of which is to enable the rider at all times to see whether the pump is actually feeding oil into the engine. The rate at which the oil passes to the engine is regulated by means of a valve with a milled head at the back of the sight feed. If this valve is screwed tightly down, no oil can possibly get into the engine If, on the other hand, this valve is fully open, one can pump oil into the engine as fast as it will run.

A pump or other such device is necessary to force oil to the crank-case. On the Douglas Motor Cycle the oil is first drawn up by the rider into the barrel of the pump; then it is made to drip automatically through the sight feed and then into the crank-case. The rate of drip can be adjusted to suit the needs of the engine, and at any time an extra pumpful of oil may be put into the crank-case by opening the drip-feed valve. This forms a singularly perfect and reliable system of lubrication. It should be mentioned that the interior of the crank-case is so contrived that the oil drops directly on the big ends of the connecting rod and that the excess oil is received into a sump (or trough) which retains a constant level. A special passage in crank-case communicates with a hole drilled in front cylinder wall, and so an additional supply of oil is fed to the front cylinders.

In practice, therefore, one determines by experiment what opening of the valve is best suited to his engine, REMEMBERING THAT, WHEN NEW, THE ENGINE REQUIRES MORE OIL THAN AFTER IT HAS RUN FIVE OR SIX HUNDRED MILES, and before which time the machine should not exceed 20 m.p.h., for the results obtained from an engine afterwards depend so much upon its careful running-in. Assuming that the crank-case is empty of oil, open the valve fully, draw a charge of oil into the pump, and then slowly

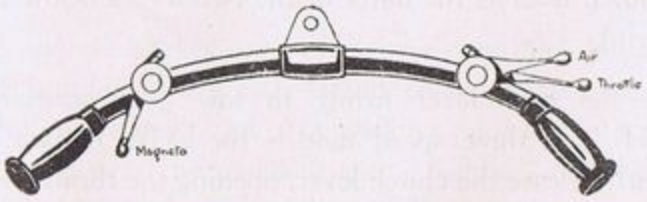
depress the handle of the pump. The oil will be seen flowing to the engine from the nozzle in the sight feed. This operation should be repeated twice after the first pumpful. Normally of course, the handle of the pump should not be pushed down at all. In actual running one simply pulls the handle up and leaves it to be returned by the pressure of the spring inside the barrel. This spring-pressure would very speedily empty the pump if only the oil could get away rapidly enough. Here the valve of the sight-feed comes into play. Generally speaking, this valve should be opened only so far as will allow THE PUMP TO EMPTY ITSELF EVERY EIGHT OR NINE MILES. This will suit moderate speeds of from 25 to 30 miles per hour. If higher speeds are indulged in, the valve should be set to allow the pump to empty oftener, say, every five miles. But for average running, the former setting will be found to afford adequate lubrication.

Open the drain tap or remove the drain plug at bottom of crank-case and drain out the stale oil every 500 miles.

HOW TO START MODELS FITTED WITH A CLUTCH.

Fill up the tank with oil and petrol, and if a new machine put three pumps full of oil into the engine. Flood the carburettor by depressing the tickler on the top of the float chamber until the petrol flows through the vent hole.

Set the magneto lever fully advanced, close the air control lever and open the throttle lever one quarter of its total movement.



THE LEVER SETTING FOR STARTING WITH A NEW DOUGLAS OR A DOUGLAS AMAC CARBURETTOR.

THE CORRECT LEVER POSITIONS
FOR STARTING ENGINE WITH OLD PATTERN
DOUGLAS CARBURETTOR

Push the machine off the stand and clip up the latter.

Stand over, or on the left side of the machine, raise the exhaust valve lever (the inner lever of the two under the left handlebar grip) place the instep of one foot on the step of the kick starter quadrant and push it down sharply.

Release the exhaust lever when the kick starter quadrant has been moved about two thirds of its complete travel.

This should start the engine and though sounding perhaps complicated the "knack" in using a kick starter is easy to acquire after a few minutes practice.

Regulate the speed of the engine by means of the throttle lever until it is running nicely, then sit on the saddle, RAISE THE CLUTCH LEVER so that the clutch is perfectly free. (The clutch lever is the outer of the two levers below the left hand grip).

Place the gear lever firmly in low gear position, *i.e.*, "FIRST" on three speed models (or LOW in two speed) and gently release the clutch lever, opening the throttle slightly as the clutch takes up the drive, and you will find the machine commencing to move slowly forward.

Should the teeth of the kick starter quadrant lock with those of the ratchet wheel, turn the flywheel slightly before applying pressure to the kick starter step.

GEAR CHANGING.

When you are securely balanced and the machine is moving at 10 or 12 miles an hour, raise the clutch lever fully and pull the gear lever from FIRST to SECOND (or LOW to TOP on two speed) and release the clutch lever again, repeating the performance later from SECOND to TOP.

STARTING TWO SPEED MODELS (WITHOUT CLUTCH).

Proceed as described above to fill up, flood the carburettor and set the levers, then stand on left of machine and push it forward slightly at the same time pushing the gear lever in notch marked "LOW."

Raise the exhaust lift lever, under left grip and walk or run with machine a few yards.

Release the exhaust lever and the engine should commence to fire; as soon as it does so, place the left foot on the footrest and throw the right leg over the saddle.

If the engine begins to run too quickly on starting, raise the exhaust lever, get on the machine, and then release the exhaust lever.

This operation takes some time to be described, but actually is quite simple and is greatly facilitated by the fact that in low gear the engine will start at a walking pace and numbers of riders stand over the machine and "paddle" off, this being the recognised method if taking a pillion passenger.

HOW TO START CLUTCH MODELS, 1912-13-14.

1.—Fill up tanks, set levers, etc., as for other models.

2.—Place gear in lever in "Low" position.

3.—Get astride machine.

4.—With left foot push forward left clutch pedal. This withdraws clutch and frees engine.

5.—With left foot sharply depress starting pedal dropping the exhaust lift at the same time, when engine should fire.

6.—With heel of left foot gently depress clutch pedal. The machine should now move away.

7.—When the machine is fairly under way, the exhaust lift should be raised and gear lever moved forward to the "High" position.

8.—The pedal operating the 1912-1914 cone clutches should be adjusted so that the heel position is exactly level with the foot board when the clutch is in

HOW TO DRIVE.

One sees constantly riders who by their harsh control of their mount are stamped as either novices or the utterly careless. The habitual use of the exhaust lifter to slow a fast-moving motor cycle is to be deprecated. Control should be always by the throttle lever, or, better still, constantly use the clutch, unless a sudden emergency demands a quick pull-up.

Sudden acceleration is distinctly bad, both for engine and transmission, whilst it is a more frequent cause of quick wear of tyres than anything else.

Change gear with care, use the clutch by fully raising clutch lever, where clutch is fitted, to avoid the sudden jarring of the pinion wheels. A seized gear box is a serious matter, and may easily be caused by a careless change of gear.

Learn to ride in a quietly confident way, controlling the engine in a sympathetic manner and using brakes and clutch with that careful precision and ease so marked with the expert rider.

NOTES ON THE SEMI-AUTOMATIC SIGHT-FEED LUBRICATOR.

This lubricator rarely gives trouble. When it does so the trouble is nearly always caused by the presence of impurities, such as grit or fluff, among the oil. Unless, therefore, one is certain that the oil is free from foreign matter it would be well to pass it through a funnel with a gauze when pouring it into the tank, but oil from a freshly-opened tin should be perfectly clean ; see that the filler caps and holes are clean.

If oil does not pass through the sight feed nozzle, notwithstanding the fact that the pump handle descends, this indicates that the bottom washer of the pump is failing to act as a non-return valve. The washer should be taken out. It may be possible to soften it and make it efficient, but probably the best course will be to fit a new washer.

If oil seems to be blown from the engine up to the sight-feed, obscuring the glass, this indicates that the air-release valve in the crank-case is stuck, or possibly foreign matter is preventing the disc from closing properly. It should be freed by an injection of paraffin, first detaching the oil pipe, or by unscrewing the valve from the crank-case and washing it in petrol ; if necessary, take it apart and clean it thoroughly.

HOW THE TIMING GEAR IS LUBRICATED.

The timing gear is lubricated automatically, the oil being fed by splash from the crankshaft to the intermediate, cam wheel and rocker spindles, which are drilled to receive the oil, while the pinion wheels and rockers receive sufficient lubricant through the release valve in the crank-shaft.

CARE OF MOTOR.

The motor as sent out, if properly used, should run for 2,000 or 3,000 miles without requiring attention. It will then probably be found that it is not quite so efficient as it was, say, after the first 1,000 miles had been covered. It will be fast enough on average roads, but probably a shade less strong on the hills. Also, when the compression is tested by turning the flywheel, it will be found that this is not quite so good as at first.

A SPEEDY OVERHAUL.

What one should do is largely a question of time available. Suppose one is about to set out on a long journey, and wishes first to give the engine an overhaul, but has only an hour or so at his disposal. Proceed thus: Put some paraffin in a basin or other large dish. Unscrew valve-caps and drop them in the paraffin. Take out valves. It is quite easy to do this with the special tool supplied in the kit. Carefully wash valves and springs with paraffin. Put in new cotters if those in use show sign of wear. If the stems of the valves are black with burnt oil, clean with fine emery. Now smear edge of each valve with fine emery powder moistened with cycle oil and grind in by turning the valve to right and left with a screwdriver inserted in the slot on the valve head; lift the valve and change its position frequently. Avoid using too much emery, as it may get through to the engine and damage the cylinder walls. Five minutes should be sufficient for the grinding-in of each valve. Wipe out all traces of emery from valve chambers with a soft cloth. Wash out valve chambers thoroughly with paraffin, allowing paraffin to run through valve guides.

Inject paraffin copiously into crank-case through plug hole provided for that purpose. Inject paraffin into each cylinder. Give engine a few revolutions. Unscrew waste-oil plug underneath crank-case and allow used oil and paraffin to drain away. Replace plug. Give engine three pumpfuls of oil. Replace valves and valve caps.

The valve tappets may be worn somewhat and require adjustment. Slacken lock-nut and unscrew tappet head until there is enough space to admit a visiting card between tappet and stem of valve. Tighten lock-nut.

If " feelers " are used to determine the clearances use 8 to 10 thou' for inlet and 10 to 12 thou' for exhaust.

Next examine the contact-breaker of magneto. Note the distance that points separate, and keep this in mind as a guide to future adjustments. If dirty, clean the contacts either with a file or with fine sandpaper. A minute drop of oil may be placed on the arm on which the bell crank lever pivots. The cleaning of the points will probably have removed so little platinum that it will be unnecessary to make any adjustment of distances between the contacts.

It may be stated that it is quite common for a magneto to run for 4,000 or 5,000 miles without attention. When an engine is firing regularly, it is sound policy on the part of the rider to leave the magneto alone.

Finally,clean sparking plugs by passing a piece of fine emery between the points. A small wire brush with petrol will be found very useful for cleaning out the cavity of the plugs.

The engine should now be practically as efficient as at first, and fit for the most arduous journey.

In practice, this list of operations is by no means so formidable as it reads, and by all persons who are in the least degree mechanically inclined will be found a most fascinating occupation.

A MORE EXTENSIVE OVERHAUL. TO REMOVE ENGINE FROM FRAME.

First detach oil and petrol pipes and exhaust-lift and magneto advance cables ; detach chain guard ; take bolt out of chain from engine to gear box on counter-shaft, undo the knurled

nut that secures the controlling slides of the carburettor, lifting both throttle and air slides out. Detach high-tension cables from the sparking plugs. Detach silencer and exhaust pipes. By removing the four bolts attaching engine to frame, care being taken to prevent engine toppling over, the engine can be lifted out of the frame. It is best to slacken induction pipe unions and valve caps before taking the engine out of the frame.

TO REMOVE CYLINDERS.

First remove induction pipe with carburettor; then undo the nuts on cylinder flanges, when cylinders can be pulled out. If the cylinders cannot easily be pulled away slightly slacken nuts clamping crank-case together.

When drawing the cylinder off the piston care should be taken to prevent the piston and connecting-rod from falling awkwardly against the crank-case; a sudden blow might cause a cracked piston. If the crank-case is not being taken apart it is advisable to stuff the cylinder holes with clean waste or duster to prevent dirt, loose nuts, etc., from getting inside the crank-case.

TO CLEAN THE CARBURETTOR.

This is held in position by two nuts fitted to corresponding studs on the induction pipe.

It is advisable to remove the carburettor, take it to pieces, and wash every part with paraffin or petrol. See that the needle valve moves up and down freely, that there is no grit in the jet or in any of the ducts, that the small hole in the lid of the float chamber is open and see that throttle barrel is perfectly clean.

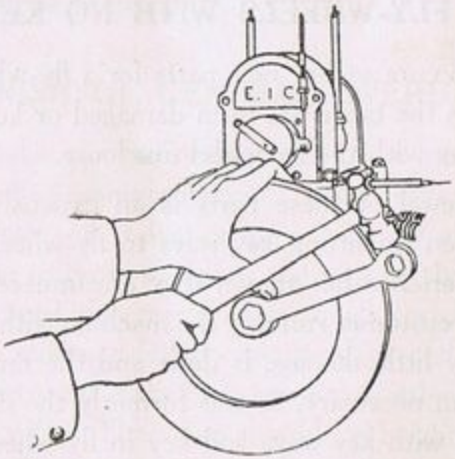
When replacing carburettor, see that the paper washer between the carburettor and the induction pipe is in position, rubbing some oil on it to ensure an air-tight joint; if this joint is in good condition it need not be disturbed, the various parts being detached from the carburettor body for cleaning.

TO REMOVE SILENCER.

Unscrew union nuts joining exhaust pipes to combustion head. The silencer must be removed before the engine can be taken apart. It is advisable to clean carbon deposit from exhaust pipes and silencer by means of a stiff wire brush. If the holes in the old pattern silencer have become choked up with mud or dust they should be cleaned out with a reamer or piece of wire.

TO REMOVE FLY-WHEEL.

After removing nut get someone to pull the wheel towards him while you give a few sharp taps on the end of shaft, first placing a piece of copper or brass on the end of shaft to prevent damage. When replacing the fly-wheel, screw the nut very tightly, using the special spanner supplied with the machine, giving it a few sharp knocks with the hammer.



We think it right, however, to caution riders that the fly-wheel should be removed as seldom as possible, as the exercise of undue force in removal may injure the ball-bearings of the crank-shaft.

TO REMOVE FLYWHEEL ON ALL-CHAIN DRIVEN MODELS.

First take off adjusting nut, springs, flywheel nut and dog washer. Get someone to pull the wheel towards him whilst you give a few sharp taps on the end of shaft, first placing a piece of copper or brass on end of shaft to prevent damage. You will now find flywheel and clutch will both come off together. When replacing flywheel, care should be taken that dog washer engages in slots on clutch body.

FLY-WHEEL KNOCK.

If on starting the engine, after the fly-wheel has been replaced, there is a metallic sound similar to a knock, it can be assumed that the cause of this is due to a loose fly-wheel. The remedy is to tighten the nut right home with the aid of a hammer, as illustrated on previous page.

1920-24 FLY-WHEELS WITH NO KEY-WAY.

There is no cure except new parts for a fly-wheel or crank-shaft in which the taper has been damaged or key-way beaten out by running with the fly-wheel nut loose.

As the renewal of these parts is an expensive matter we have now given up fitting key-ways to fly-wheels and crank-shafts, as experience has shown they are unnecessary, also in the event of a customer running the machine with the fly-wheel nut loose very little damage is done and the renewal of both parts is seldom necessary, as was formerly the case in similar circumstances with key ways and key in fly-wheel and shaft.

The new type fly-wheel and shaft can be fitted to models made before 1920, also if a new shaft only is required the new pattern can be used quite satisfactorily with the old type fly-wheel and key-way, provided the taper cone is perfect and the key-way has not been beaten out.

In 1912 and early 1913 the crank-shaft webs were not quite so wide as now. If a new crank-shaft is required for these early models the latest type can be used by scraping out the crank-case to take the wider shaft.

If any trouble is experienced in doing this we shall be pleased to undertake it for customers if the crank-case *only* is sent to our works.

REMOVAL OF MAGNETO.

This, of course, can be readily effected by unscrewing the nuts at each side, after the timing-wheel has been removed from the end of the magneto or armature shaft. However, we cannot impress too strongly upon the average user of our machine that the magneto should never be removed unless (*a*) there is something seriously wrong with the magneto itself, or (*b*) there has been some breakage inside the crank-case which renders it necessary to take this apart. The engine can be thoroughly cleaned and tuned up without the fly-wheel, magneto-fixing, or crank-case being interfered with. Before sending out the machine we are very careful to see that the magneto is properly timed.

FINISH OF GENERAL OVERHAUL.

Assuming that the engine has been taken apart as indicated in the preceding paragraphs—*i.e.*, has had removed from it the carburettor and induction-pipe, silencer and cylinders—the first thing to do is to scrape the tops of the piston with a blunt knife until they are free from all carbon deposit. If either ring is gummed fast it must be slackened—an operation requiring great care, as the rings are very brittle—it is best done with a pen-knife. The rings should be bright and polished. If any ring is discoloured, this indicates that gas is getting past it; a new ring is then necessary. The rings should not be

too loose in the grooves, and should be tested in the cylinders after they have been tried in the grooves. The gap should not exceed 4/1000ths of an inch when the ring is pushed halfway up the cylinder barrel. Carbon deposit is generally found behind the rings in their slots and on the inside of the piston head; it should be scraped away and slots polished out with a narrow strip of emery cloth. The crank-case—inside and out and the pistons should then be thoroughly cleansed with paraffin, and put aside in a clean place to drain. The cylinders should now be taken in hand and the valves removed. All carbon deposit should be chipped from the heads of the cylinders by means of a long, blunt and heavy screwdriver. The exhaust valves should next be ground in position. It is rarely necessary to grind in the inlet valves. If the valve seatings are badly worn the valves should be refaced in a lathe. The cylinders should be very thoroughly cleansed with paraffin and replaced in the crank-case. Before doing so the sides of the pistons should be smeared with a thin film of engine oil. Take care that the gaps in the rings are not in line, and that the rings are moving freely in their slots.

When the cylinders have been secured, the valves should be put in position and other adjustments made as described on pages 37 to 38. The engine should then be re-attached to the frame, special care being taken to secure an equal tension to each of the four nuts securing the engine to its cradle (*e.g.*, if the lower nuts are screwed up harder than the upper nut the engine will be out of alignment). A simple way to test the alignment of the engine in the frame is to glance at fly-wheel, comparing it with the vertical gear operating rod.

After some considerable use the valve guides may require renewing. These guides are detachable on all engines made since 1915 and are simply a tight fit on the valve pocket. They can be removed with hammer and punch, and when fitting

new guides use a piece of wood between hammer and guide to prevent damage.

Before starting up the engine, three charges of oil should be injected into the crank-case.

It will, as a rule, be found that the engine has much more life in it after its general everhaul. It certainly should not be necessary to do this oftener than once in 3,000 miles ; and, if care is taken with the lubrication, it may run much further without internal cleaning.

TIMING THE MAGNETO.

If for any reason the magneto has been removed, the following is the method of timing it :—

Turn flywheel round until the exact moment of closing of the exhaust valve of either cylinder is reached. The piston should then be at the outward end of the stroke. On older models this position may be located by the key-way in flywheel being at the rear of machine. (Since 1920 2¾ H.P. engines have no key-way. (See note on p. 34).

When the rear valve just closes, the front cylinder is at the firing-point, and *vice versa*, and the following instructions are given assuming that the timing is effected when rear valve closes (*i.e.*, one is timing the spark for the front cylinder).

Place magneto advance lever midway between full advance and full retard and turn magneto driving wheel until the contacts are just separating, by the fibre tip striking the upper steel segment on contact-breaker. The gears can then be meshed and the magneto secured.

When the spark is correctly timed for one cylinder it is correctly timed for both

While it is right to explain the method adopted in timing the magneto, in practice this information will not, as a rule, be found necessary, as the magneto wheel should be marked before removal.

TIMING THE EXHAUST VALVE.

The valve-chamber is on the outside of the crank-case. Access to it is obtained by removing (*a*) the carburettor and induction pipe, and (*b*) the cover of the valve-chamber, which is secured by screws.

Two things have to be kept in mind :—

(1) The exhaust-valve closes just the least shade, say one-sixteenth inch, after the piston has completed the exhaust stroke.

(2) The inlet-valve opens a shade, say one-thirty-second inch, before the piston has begun the induction stroke.

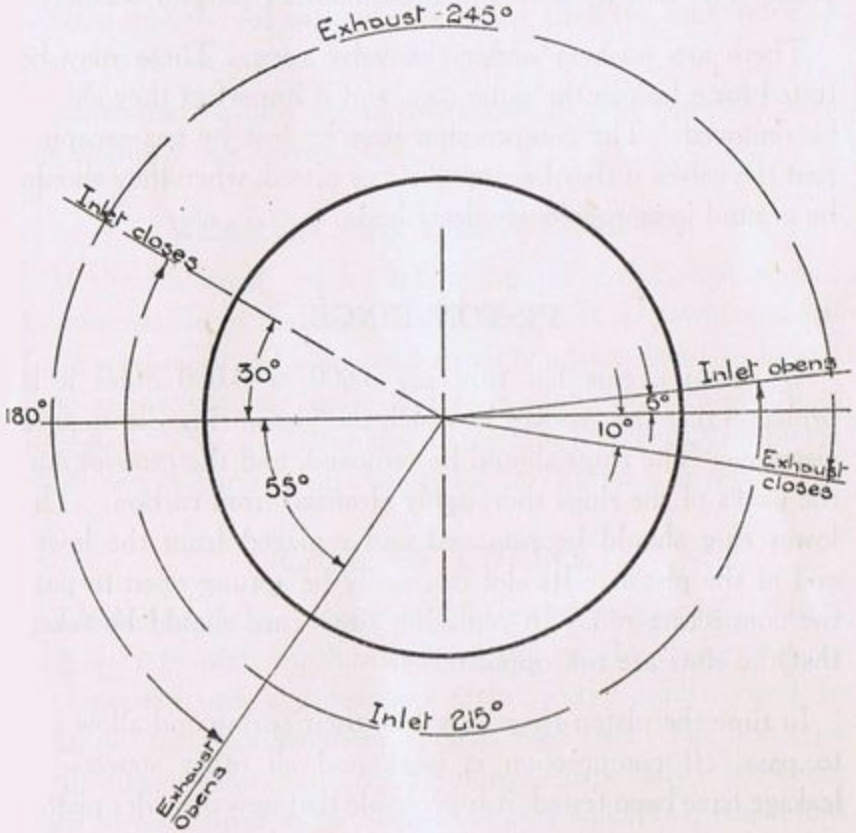
Time for one cylinder. If the valves of one cylinder are accurately timed, the others become accurate automatically.

Remove cage and washers securing spindles of timing wheels. Slacken nut securing toothed wheel to which valve cams are attached. Slacken this wheel by pulling it forward.

The inside cam operates the exhaust valve.

Bring piston to top of its stroke. Move round cam against valve tappet (in direction opposite to fly-wheel) till cam has just ceased to bear against tappet. Move fly-wheel forward so that piston descends one-sixteenth inch. Mesh gears. Every valve will now be found to be accurately set.

As the gears are now accurately marked for timing, in practice it is only necessary to see that the wheels are meshed with the markings opposite to each other.



Valve Setting, 5b Cam, 2¾ h.p. Standard Douglas Engine.

COMPRESSION.

A loss of compression may sometimes be traced to a faulty spark plug, or spark plug washer. These can be tested by smearing them with engine oil and trying the compression, when, if they are leaky, the oil will bubble at the defective part. The remedy is to substitute another plug or washer.

There are washers under the valve caps. These may be tested for a leak in the same way, and if imperfect they should be removed. The compression may be lost by gas escaping past the valves if they become dirty or pitted, when they should be ground in as previously described.

PISTON RINGS.

When an engine has run, say 3,000 or 4,000 miles it is probable that the grooves in which the piston rings lie require cleaning. The rings should be removed, and the grooves and the backs of the rings thoroughly cleansed from carbon. The lower ring should be removed and replaced from the lower end of the piston. Its slot can easily be sprung open to pass the connecting-rod. In replacing rings care should be taken that the slots are not opposite.

In time the piston rings may lose their spring and allow gas to pass. If compression is weak and all other sources of leakage have been tested, it is probable that new or wider piston rings are necessary.

VALVE SPRING-TENSION.

After a time the valve-springs may lose their temper and become too weak. This should not happen for several thousands of miles; but if it is suspected that this is the cause of irregular running, new springs should at once be inserted.

It will be observed that the ends of the valve-springs that lie nearest to the engine are always weaker than the other ends on account of the heat which they have to withstand. When replacing the springs after they have been removed for any reason, be careful to replace the compressed ends next to the engine. Otherwise both ends will be affected by the heat, and the spring will be injured.

Riders are recommended to carry an inlet valve and an exhaust valve complete (*i.e.*, with spring and cotter) as spares.

Note that the exhaust valve is longer than the inlet valve so that the valves are not interchangeable.

Remember, a new set of valve-springs will generally give the engine a new lease of life.

WEAR IN BIG END BEARINGS.

If the big ends require taking up the crank-shaft should be removed from the case for this work. It is, however, a job for a mechanic, and we would strongly advise riders to have a new set of big end bolts and nuts each time this work is necessary. See p. 91 for instructions how to send the motor cycle or any parts to our works for the purpose of repairs.

CARE OF CHAINS.

Lubrication.—The object of lubrication is two-fold. It is necessary to keep the lubricant in and on the chain, first, to to serve the ordinary purposes of lubrication, and second, to keep out foreign substances, such as road grit. The best type of lubricant to serve this double purpose,especially if the chain runs without cover, is the semi-solid kind which becomes liquid when melted—preferably a mixture of grease and graphite. A good example of this class is Price's "Rangraphine," or Acheson's "Gredag." The chain to be treated should first be washed thoroughly free from grit and dirt in paraffin, and then

dried. It should next be warmed for some time in the lubricant, at about the temperature of boiling water, and then left to cool, the excess lubricant being wiped off. Under load, the lubricant will gradually be squeezed out ; the process should be repeated before the chain gets dry.

A rider should no more neglect the chain, which is a vital part of his machine, than he should neglect the lubrication of the engine.

Adjustment.—If the chain is too slack it is apt to "whip," which intensifies the wear and tends to break the rollers. If, on the other hand, it is too tight, a crushing effect is produced on the rollers, and the whole chain is strained unduly. A chain should be adjusted, and kept adjusted, so that it can be pressed down with the finger $\frac{1}{4}$-in. and never less than $\frac{1}{8}$-in. Adjustment of the chain is provided by sliding the counter-shaft or gear box. On the C/W Models adjustment of rear chain is provided for by screws and locknuts on rear wheel lugs.

Repairs.—A chain can easily be repaired with the assistance of the stud extractor found in tool kit of C/W Models and a few spare parts. This tool provides a simple means of removing the rivets, which should not be filed down, as they are case hardened. It can also be used for putting in a new outer link.

The process of removing a rivet consists in forcing the rivet head out of the side plate by turning the screw. Both rivets in the link have to be forced out, some care being necessary so as to place the chain that the under side-plate can fall away between the jaws of the tool.

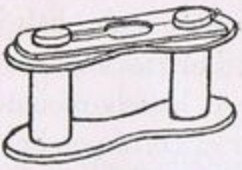
Four parts are necessary to effect repairs in a chain :—

1. Spring clip joints for quick road repairs, and generally as a joining up link.

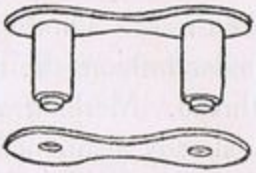
2. New outer links for more leisurely and permanent repairs.

3. New inner links, consisting each of two side-plates, two bushes and two rollers, and—

4. Cranked joints for joining up a chain with an uneven number of links. Such a chain can be shortened by one link by removing the cranked link, and a chain containing an even number of links can be shortened to the same extent by removing two pitches and inserting a cranked link.

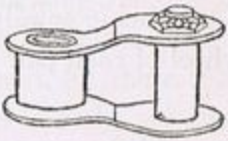


Spring Clip Joint



Outer Links

Inner Links



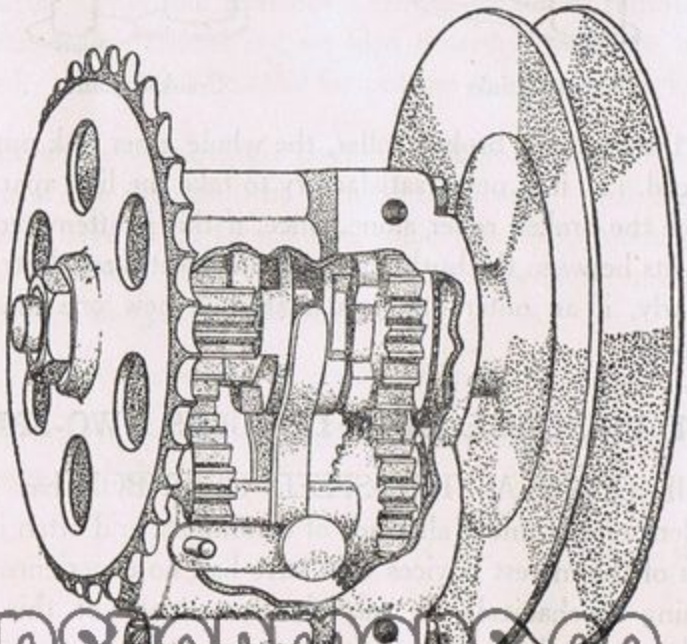
Cranked Joints

In the case of a broken roller, the whole inner link must be replaced, *i.e.*, it is never satisfactory to take the link apart and replace the broken roller alone, since, if this is attempted, the force fits between the bushes and the side-plates are destroyed. Similarly, if an outer link is damaged, a new one must be employed.

THE PRINCIPLE OF A DOUGLAS TWO-SPEED

THE DOUGLAS TWO-SPEED GEAR BOX has given excellent results under all kinds of conditions, and often in the hands of the merest novices who have had no experience with anything mechanical. It was the forerunner of this now popular type—the countershaft gear.

Simplicity is its chief point. It comprises a main shaft with a central squared portion, on which slides a double faced dog-clutch, controlled from a convenient position on the top tube through the medium of a striking fork and the necessary operating rods. On both ends of this shaft, which are grooved with oilways, are mounted gear wheels of unequal size and formed with a dog-clutch on the inner sides and extensions on the outer sides. These extensions carry the ball races, on which the whole shaft revolves when the high gear is in use. On one extension the chain wheel is held by a key and nut with left hand thread. On the other end of the main shaft is fixed, in a similar fashion, the belt pulley, but this nut has a right hand thread. Meshing with the two loosely-mounted gear wheels, already mentioned, are a pair of corresponding wheels on the lay shaft, machined from the solid. Thus the two-speed gear-box is composed of two pairs of gear wheels, one wheel of each pair being solidly mounted on the lay shaft, while the other wheel of each pair is loosely mounted on the main shaft.



HOW IT WORKS.

When the sliding dog-clutches are in the centre of the squared portion and not registering with the corresponding dogs formed on the main shaft pinion wheels, the gear is in the neutral position ; the first pinion to which the chain wheel is attached is in mesh with the first pinion of the lay shaft, which is formed solid with the second lay shaft pinion, which in turn is in mesh with the second main shaft pinion. Thus all wheels run idly and no power is transmitted to the belt pulley. This neutral position should only be used when wheeling the machine ; on no account should one attempt to start by shifting from this position into low gear to start away, if the engine is running.

Now if the sliding dog-clutch is moved to the right till it engages with the second main shaft pinion, it is obvious that this wheel will drive the main shaft, and thus the belt pulley, as the dog member is mounted on the square portion of the shaft. Thus the low gear is obtained, for there is a reduction in ratio between the driving wheel and the lay shaft. If, on the other hand, the dog-clutch is moved to the left till it engages with the first pinion, which carries the chain wheel, it will be seen that the main shaft and with it the belt pulley, will be driven direct ; thus top gear is obtained. The lay shaft will still be revolving, and with it the second main shaft pinion, which will be carried round in the same direction as the main shaft, but at a lower speed. It is important that the above description should be carefully followed, for, broadly speaking, it is the basis of all countershaft gear boxes.

CARE OF THE TWO-SPEED GEAR.

To lubricate the two-speed gear, inject into the gear-box some thick grease or heavy engine oil as used for the gear-boxes of motor cars, using the grease-gun supplied.

One grease-gun full is sufficient for 500 to 600 miles; at the same time the chain may be examined to see if it is at the proper tension.

If the chain is sufficiently slack to require tightening, this can be done by slackening the two nuts which hold the gear box to the frame, adjusting the chain guard also if necessary, and sliding it back until the chain has the proper tension, then screw nuts tightly.

If at any time the gear should get out of adjustment and is not free when indicated by free engine position, or if a clicking noise should be heard from the gear-box when the machine is wheeled with lever in "free" position, the set-screw on the adjusting rod between the bottom lever and the gear box should be slackened, the pulley-wheel turned, and the adjusting-rod shifted until the dog-clutch is in a free position; the screw holding the two rods rigid may then be tightened.

MAINLY ABOUT GEARS.

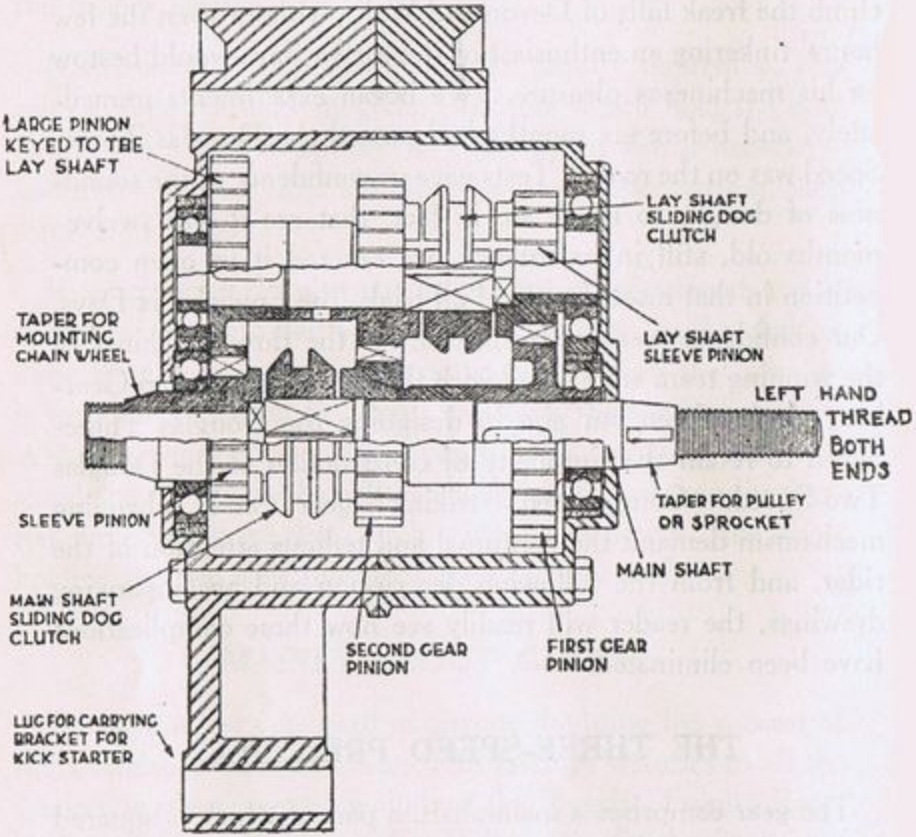
We have never yet heard of anyone doubting the success of the Douglas Two-Speed Gear. In fact, its victories in all the world's greatest events, including the Tourist Trophy Races both in the Isle of Man and at Brooklands Track—its unparalleled success in the Irish End-to-End—the English Six Days' Trial and the Melbourne to Sydney Overland Event, leave very little room for doubt. We were the first to recognise the necessity of a two-speed gear, and justly claim the honour of originating and popularising the particular type of gear known as the Countershaft. Having established such a position in the motor cycle gear world, we were naturally anxious to retain so envied a reputation. Therefore it was our object, as the pioneers of the Three-Speed Countershaft Gear, to produce something just as simple, successful and original as our two-speed type.

For some considerable time we had discussed the pros and cons of standardising the Three-Speed Gear, and it was during 1913 we came to the conclusion that in the early future the public demand would be for the addition of an extra gear. They would expect to use a machine for 6,000 or 7,000 miles without attention, attach a side-car without discretion, and climb the freak hills of Devon and Wales without even the few hours' tinkering an enthusiast of the earlier days would bestow on his machine as pleasure. We began experiments immediately, and before six months had passed the Douglas Three-Speed was on the road. Tests gave us confidence of the soundness of design, so much so, in fact, that ere it was twelve months old, still in its infancy, we entered it in open competition in that most drastic of all trials, the English Six Days. Our confidence was not misplaced, for the three machines of the winning team were fitted with the new Three-Speed Gearbox. It has been our aim in designing the Douglas Three-Speed to retain the simplicity of construction of the Douglas Two-Speed. Complicated striking gear and changing mechanism demand the continual and tedious attention of the rider, and from the following description and accompanying drawings, the reader will readily see how these complications have been eliminated.

THE THREE-SPEED PRINCIPLE.

The gear comprises a main-shaft, a part of which is squared and carries a sliding dog-clutch, while the extreme left is grooved with oil ways and acts as a bearing for the sleeve pinion. An extension of this pinion carries the driving chain sprocket, and the opposite face a dog-clutch. Mounted centrally on the main shaft will be found the second gear pinion wheel, which is free to revolve independent of the shaft. On the left face of the second gear pinion is machined a dog-clutch, which is free to register with the previously

mentioned sliding dog. The next pinion mounted on the right of the main shaft is the first gear wheel, which rotates with and not independent of the main shaft on which it is rigidly mounted by two Woodruff keys. On the extreme right of the main shaft, mounted by the usual taper and Woodruff



key, is the rear chain sprocket or belt pulley which drives the rear wheel. This completes the main shaft, but before proceeding to discuss the lay shaft it will simplify matters considerably if the reader understands that the lay shaft is nothing more or less than another main shaft with the extensions for carrying the chain wheel removed. It carries similar first, second and third gear pinions, as well as a similar sliding dog,

but with just this difference—the positions are reversed, that is to say, the sleeve pinion on the left of the main shaft becomes the sleeve pinion on the right of the lay shaft, the sliding dog on the left of the main shaft becomes the sliding dog on the right of the lay shaft, and so on.

About the Operating.

It is obvious, from the foregoing, that contained in the gear-box are two sliding dog-clutches on opposite shafts, which must be operated by some mechanism in such a way as to move conjointly or independently of each other. It is just in this important and critical part that the Douglas gear differs from all others, and, by our patented system, not only are these operations carried out without the aid of a complicated cam or gate system, but also the whole of the shock and harshness usually found in all gears of the dog-clutch type has been eliminated. The mechanism is simplicity itself, and consists of a hardened hollow spindle, mounted centrally between, but running parallel and above, the main and lay shafts, housed in the aluminium case. Externally mounted on this spindle are two bronze forks. The left fork operates the dog-clutch on the main shaft, while the right operates the lay shaft dog-clutch. These bronze forks are mounted in such a way that permits of only a limited sliding motion, and is governed by the action of two steel pins working in corresponding slots machined in the hollow spindle. Mounted centrally between the bronze operating forks is the main operating fork connected to the usual change speed lever on the top rail of the frame. Housed internally in the hollow spindle which carries the operating forks will be found a small tie-rod, the duty of which is to retain two coil springs in such a position that when the springs come in contact with the steel pin of the bronze forks they return the forks actuating the dogs to the position permitted by the main operating fork.

which in its turn is controlled by the rider. It is these springs that are directly responsible for the sweet change that has replaced the usual jerk associated with dog-clutches. If the reader spends but a few seconds glancing at the accompanying drawing, he will readily see the action of the operating gear.

The Gear in Action.

Now let us follow the gear in action, and to do this it is much simpler if the second gear is taken as the starting-point for when this gear is in position the main operating fork is central and both springs have exerted their energy and returned the dog clutches to the farthest distance permitted by the guides. It will be obvious from this that if the exterior operating rods be detached from the interior control the dogs will immediately return to such a position as to bring the second gear in action.

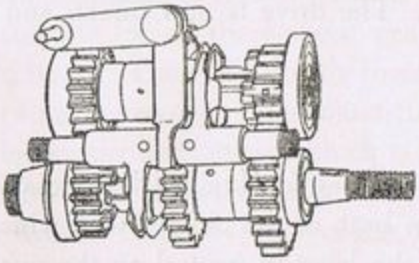
ADJUSTING THE THREE-SPEED GEAR.

It is well to keep this point in mind when adjusting the driving chain, which necessitates altering the gear-box position. The easiest method of adjusting the gear control is to place the gear lever into second position on the tank quadrant, free the adjusting bolt of the operating rod, turn the chain wheel once or twice backwards and forwards to make sure the dogs mesh, and then tighten the adjusting bolt, and the operation is completed.

The Second Gear.

With the second gear in position, the drive is taken from the sleeve pinion on the left of the main shaft to the large pinion, which is held rigidly to the lay shaft. It is now conveyed, through the lay shaft dog-clutch, to the central pinion on the lay shaft. This in turn meshes with the central main shaft pinion, which, being in register with the main shaft dog

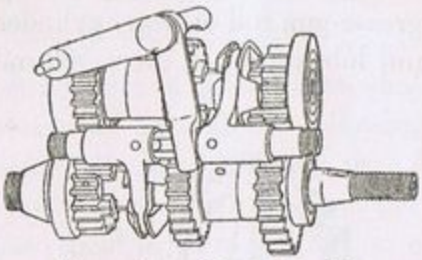
clutch, conveys the drive to the main shaft on the right extension of which the rear chain sprocket or pulley is mounted.



Second Gear in Position

The First Gear.

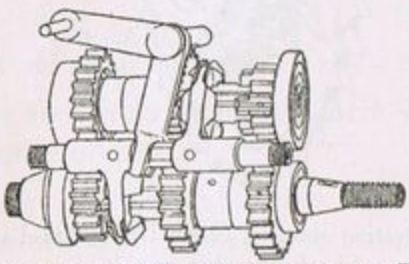
For the first gear the operating fork is moved to the right when the lay shaft dog registers with the smallest pinion on the lay shaft. The drive then is through the two end sets of pinions, the central set merely running idle.



First or Low Gear in Position

The Third Gear.

For the third gear the operating fork is moved to the left, when the main shaft dog is brought to register with the sleeve



Third or Top Gear in Position

pinion, and simultaneously the left-hand control spring exerts its energy and returns the lay shaft dog till it meshes with the central pinion. The drive is now direct, and all pinions are idle.

Neutral.

The neutral position is obtained by releasing the lay shaft dog-clutch from both of the pinions with which it is made to engage. With the lever in neutral on the quadrant, this dog is midway on the squared portion of the lay shaft. A second neutral position may be obtained by placing the main shaft dog midway on the squared portion, but this position is not marked on the quadrant as it would serve no useful purpose.

Lubrication of Three-Speed Gear.

Inject half a grease-gun full of heavy cylinder oil or mixture of gear grease and lubricating oil every 500 miles.

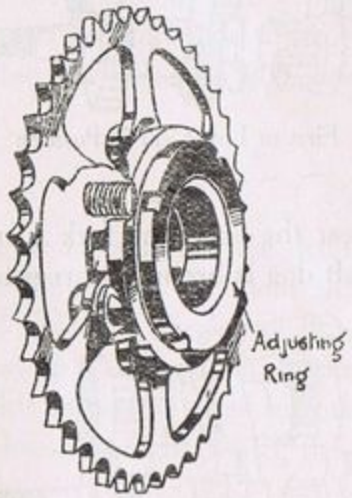


Illustration showing Chain Drive Wheel with Shock Absorber combined.

THE ADJUSTABLE PULLEY.

Two types of adjustable or variable pulleys have been supplied by us, one suitable for all three-speed gear-boxes, the other for two-speed boxes. They vary greatly in construction and are therefore not interchangeable. To adjust the three-speed gear pulley, first loosen the locking cap, which is a left-hand thread, when the right-hand threaded flange will be found free to move in any desired position—unscrewing, of course, to lower the gear ratio.

This adjustment may be easily carried out with the aid of the special spanner contained in the tool kit, using a hammer to start the locking cap turning.

The adjustable pulley of the two-speed gear is altered in a similar way with the exception of the lock-nut being a right-hand thread. By unscrewing the flange one complete turn the gear is lowered another quarter.

For the convenience of those riders who care to experiment with gear ratios we append the following tables. We can, however, assure all riders that the time spent in obtaining the correct ratio for their purpose and particular district will be more than repaid in extra satisfaction obtained from their mounts.

RATIOS WITH THREE-SPEED GEAR-BOX.

High	Second	Low
$5\frac{3}{4}$	$8\frac{5}{8}$	$12\frac{15}{16}$
6	9	$13\frac{1}{2}$
$6\frac{1}{4}$	$9\frac{3}{8}$	$14\frac{1}{16}$

It will be seen from the above there is a 50% reduction on each change of gear.

Sprockets to give lower top gear for sidecar work can be supplied for the C/W Model we recommend at top gear of 7 to $7\frac{1}{2}$.

RATIOS WITH TWO-SPEED GEAR-BOX.

High		Low
$5\frac{1}{4}$	.. ..	$8\frac{3}{16}$
$5\frac{1}{2}$	.. ..	$8\frac{9}{16}$
$5\frac{3}{4}$	.. ..	9
6	.. ..	$9\frac{3}{8}$
$6\frac{1}{4}$	.. ..	$9\frac{3}{4}$

The two-speed box gives a 56% reduction.

HOW TO USE A CLUTCH.

We think it right to give some riders advice as to the best means of using the clutch, whatever the type.

We find clutch models have been greatly appreciated. The clutch is by no means a necessity, but there are many occasions when the rider finds the clutch a great convenience, as for instance, when starting on a hill or in crowded thoroughfares. One rider instances a case in which he finds it of the utmost utility. He frequently takes his machine across a ferry, the road from which is rough, narrow, winding, and very steep. There is no room to start the machine by ordinary methods, and formerly he had to push for 200 yards—no light task on a warm day. Now he starts the engine on the landing stage, sits across the machine, slips in the clutch, and climbs up into the main road with ease. For that experience alone, he affirms the free engine and clutch is worth the extra cost. No doubt many others can suggest parallel instances.

In traffic the clutch is of great utility. Though one may have reduced the speed to a mere crawl on the low gear, there are times when it is necessary to draw up altogether. Without a clutch this means a dead stop and an undignified descent from the machine. With the free engine pressure on the clutch reduces the machine to the lowest pace at which it can be balanced; or, if that is still insufficient, one foot may be

put on the ground while the clutch is out of engagement. Whenever the traffic block is cleared, releasing the pedal sets the machine again in motion. Remember always to accelerate before engaging the clutch.

It is necessary to declutch when changing the gears—in no case should a change of gears be attempted without this being done. In changing from high to low it is desirable to race the engine slightly before the gear lever is moved. As a rule, a change will not be made from high to low until the pace of the machine is sufficiently reduced to permit of this being done.

ON ALL CHAIN DRIVEN MODELS, IT IS ESSENTIAL THAT THE CLUTCH BE USED WHEN CHANGING GEAR, AND IN NO CASE SHOULD A CHANGE OF GEARS BE ATTEMPTED UNLESS THIS IS DONE.

DO NOT ALLOW THE ENGINE TO RACE

We have noticed many instances of gross abuse oft he clutch. Some riders seem to forget (*a*) that the engine is not water-cooled, and (*b*) that a high-speed engine cannot be raced for any length of time without some degree of injury. Sometimes the engine is allowed to race when free for purposes of ostentation on the part of the rider. Recently one of our staff reported that he had seen a rider start up his engine, and then, while it was racing at something like 2,500 revolutions per minute, deliberately fill and light his pipe, put on an overcoat and gloves, before getting on the machine. It says much for the engine that it stood this treatment at all, but it may be stated that such practices, if persisted in, will bring any high-speed air-cooled petrol motor to a premature end.

When the engine is started by the kick-starter, the throttle should at once be closed so as to pass the least amount of gas that will keep the engine running.

The only permissible acceleration is just before one engages the clutch, so as to prevent the strain of starting from stopping the engine.

When the clutch is used in traffic, equal care should be taken to prevent racing or heating.

If these precautions be adopted, the clutch will be found a most valuable addition to the motor cycle. Indeed, it may be affirmed that no rider of a motor cycle with free engine and clutch would ever go back to the old type of fixed gear.

TO COAST WITH A TWO OR THREE-SPEED MACHINE WITH HANDLE-BAR CONTROLLED CLUTCH.

Close the throttle and open air lever fully and declutch. Before reaching the bottom of the hill close the air lever, open throttle slightly and gently let the clutch in, when the engine will start up without trouble.

DO NOT COAST.

When the engine has simply a two-speed gear and no clutch, coasting should never be indulged in. Many riders have attempted to do so on a hill by setting the gear-lever in the neutral position. When the bottom of the hill is reached they endeavour to engage the gears. The difference between letting in the clutch as just described and engaging the gears is that the clutch, if properly manipulated, takes up the drive very gradually, and no sudden strain is communicated to the engine and gears. But the action of the gears is positiye, and an attempt to start the engine by their use places such a violent strain on all parts of the machine that damage is almost bound to ensue. A great many of the breakages reported to us arise from this cause.

If a rider is determined to coast down hills with a simple two-speed model, he must be prepared to stop at the bottom of the hill and start the machine afresh in the ordinary way. But riders should recollect that the engine itself forms a most valuable brake, and that, when coasting in the manner described, one is wholly dependent on the ordinary brakes.

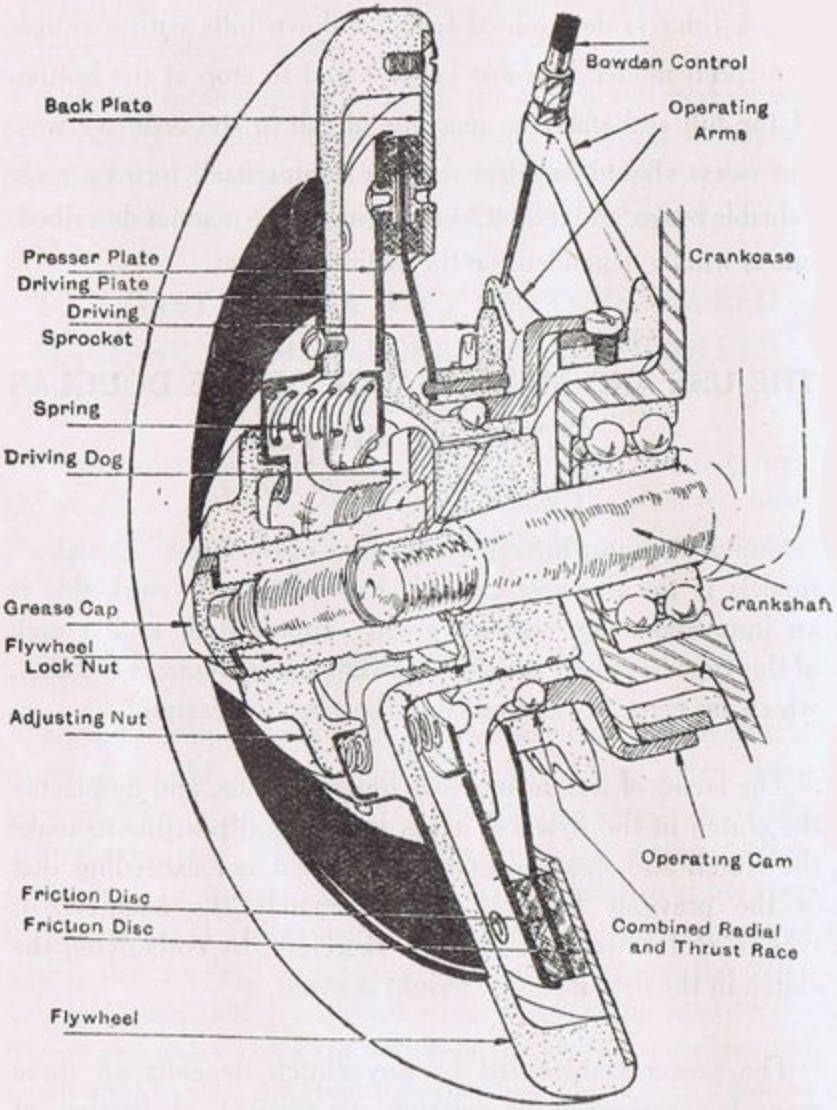
THE USE AND MAINTENANCE OF THE DOUGLAS FLYWHEEL CLUTCH.

(Douglas-Bailey Patent No 205680.)

One of the most interesting features of the latest "Douglas" models is the flywheel clutch. For motorcycle work this is an innovation that will be greatly appreciated, as a clutch of this type has many advantages over existing types of clutches, which are generally embodied in the gear box design.

The factor of weight is a very important one, and by placing the clutch in the flywheel it has been found possible to make the clutch and flywheel of a total weight not exceeding that of the previous flywheel. Approximately the countershaft type of clutch weighed 14-lbs.; therefore, by embodying the clutch in the flywheel, this weight is saved.

The power transmitted by any clutch depends on three main factors—speed of rotation, co-efficient of friction of materials used, and the mean radius of the friction surfaces. It is obvious that the load on the friction surfaces—which is one of the determining factors in the life of the materials employed—decreases as the speed increases for any assumed power to be transmitted. Further, by the law of leverages, the greater the mean radius of the friction surfaces the lower



the load for the same torque transmitted. Therefore, to compare the flywheel with the usual clutch on the gear box, the former has the following advantages :—

The speed of the clutch is roughly double that of the gear box clutch, and the mean radius of the friction material is

much greater, so that in both directions the flywheel clutch has the advantage. Again, by using the clutch embodied in the flywheel, the gear box load is considerably lightened, because the weight of the clutch on the driving sleeve pinion, which greatly overhangs its bearing, and which is usually unsupported, is eliminated.

The task of putting all the desirable features of an ideal clutch into a flywheel, yet retaining its perfect and inherent balance, together with accessibility and ease of adjustment, had been found one of some difficulty. These features, however, have been obtained after very considerable thought and careful experiments. From the illustration it will be seen that there are only six parts in the clutch—the flywheel, which also acts as a clutch body, the back plate, the centre plate, which is a driven plate, and the pressure plate upon which the springs act. To alter the load capacity of the clutch, the nut on the outside has merely to be adjusted to give the required grip. The pressure plate is driven by a key, clearly shown in the sketch, and has a bearing of large diameter on the flywheel boss. This large bearing prevents one of the commonest troubles found in clutches—the binding of the pressure plate on its key or castellation.

The boss must have careful attention at any time the clutch is dismantled, because if the pressure plate does not slide freely on this bearing, the working of the clutch will be very seriously interfered with. If it be carefully assembled, it should give no trouble for at least 10,000 miles. Lubrication is provided for by a central lubricator. Two turns of the grease gun every 300 to 400 miles should be given, use Wakefield's Transmission Grease.

The pressure plate is made with deep radial ribs to give great rigidity, so that when the spring pressure is applied, there is no distortion or whipping, the whole of the spring

pressure being passed on to the driven member. The driven member is a very light, steel plate, riveted to the sprocket. It is made flexible, and is the reverse of the pressure plate and back plate in this respect. The two latter plates are expected to be absolutely rigid under all circumstances. The driven member is expected to conform in almost any direction to the pressure exerted upon it. It is therefore made of very light gauge spring steel, so that it will flex.

The sprocket is mounted on a radial bearing, the inner race for which is cut in the boss of the pressure plate. This bearing has only to take a light radial load when the clutch is released. When the drive is taken up by the clutch the whole is locked rigidly together. For disengaging the clutch the radial bearing serves the purpose of a thrust bearing, against which a conical face on the releasing lever is pressed, thus relieving the friction surface from spring pressure. It is important to remember that as the adjusting screw is screwed up to accommodate wear of the friction material, THE RELEASING ARM MUST BE LIKEWISE ADJUSTED BY LENGTHENING THE BOWDEN WIRE; otherwise the spring pressure is exerted on the ball bearing and on the cam face instead of the pressure plate. This is very important and there should be at least 1/16″ of play between the operating cam and the row of balls.

Another point to note is that after overhauling, the clutch should be cleaned out; Ferodo and other lining materials form a considerable amount of dust, and unless this is removed from the clutch body it will gradually pack up between the periphery of the clutch plate and the inside of the flywheel, and eventually prevent the clutch functioning.

In assembling the clutch after overhauling it will be seen from the illustration that the whole of the parts, with the exception of the springs, flywheel nut and washer, or driving key and the adjusting nut, can be assembled and placed on the crankshaft as a single unit. There should be at least 1/16" clearance between the end of the shaft and the face of the flywheel boss, with the flywheel forced on the shaft. With this correct, insert the driving key, which acts as a washer to the flywheel lock nut, then screw up the lock nut. It is essential that this nut is absolutely tightly secured. With the lock nut in place the three springs should be inserted, their retaining washer put into place, and the adjusting nut screwed on. Under no circumstances should the adjusting nut be screwed tighter than necessary. It is well to try the clutch three or four times, and adjust until all slipping is prevented. Care should be taken that as this nut is screwed up the cam operating lever is allowed to go back towards the crankcase by lengthening the Bowden operating wire.

It is advisable to remove the Bowden wire nipple from the operating arm, and allow the arm to fall free, until the required adjustment of the spring pressure has been obtained. It will be appreciated that as the Ferodo plate wears, so the spring pressure will require adjustment, and the operating lever resetting accordingly. The life of the fabric is very considerable, also the life of the clutch with ordinary use, and it will stand a great amount of abuse.

In dismantling all that is necessary is to remove the adjusting nut, the springs and ring, the flywheel lock nut and then the driving key. The flywheel, together with the remainder of the clutch, can then be removed from the shaft with the withdrawal tools supplied.

THE DOUGLAS DRY PLATE CLUTCH.

(British Patent No. 127099 (Bailey-Douglas Patent), and under International Convention.)

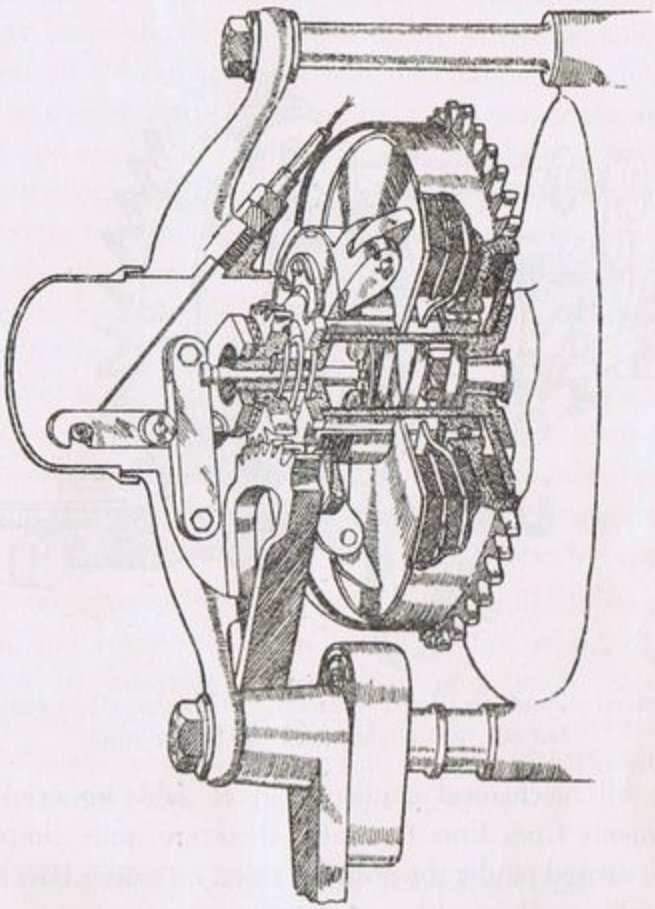
INSTRUCTIONS FOR THE USE, CARE, AND ADJUSTMENT.

This clutch was used on three speed gear boxes up to end of 1923. We have had considerable experience of all types of clutches, including the external and internal cone, multiple disc and the cork inset, and we are of the opinion that all these possess inherent faults that cannot be overcome so far as clutches for motor cycles are concerned.

It must be remembered that a motor cycle clutch is subject to much more abuse than any other clutch, for in ninety-nine cases out of a hundred the motorist gains his initial experience on a motor cycle and the clutch bears the brunt of his unskilful handling. Again, the designer of a motor cycle clutch, unlike the designer of a car clutch, has very limited space at his disposal, and therefore the lack of surface area is much too frequently made up by spring pressure.

In the past we have found the cork inset clutch extremely satisfactory, but it is not indestructible when used as a variable gear, as is often the case. It will be found that the *Multiple Dry Plate Clutch* is exceptionally simple, though very unconventional in design. It possesses many advantages, as it may be slipped indefinitely without causing the slightest damage. It may be run dry, and is practically oil, water and filth proof. Being large in area, the needed spring pressure is comparatively light, and the ingenious use of levers to distribute this pressure

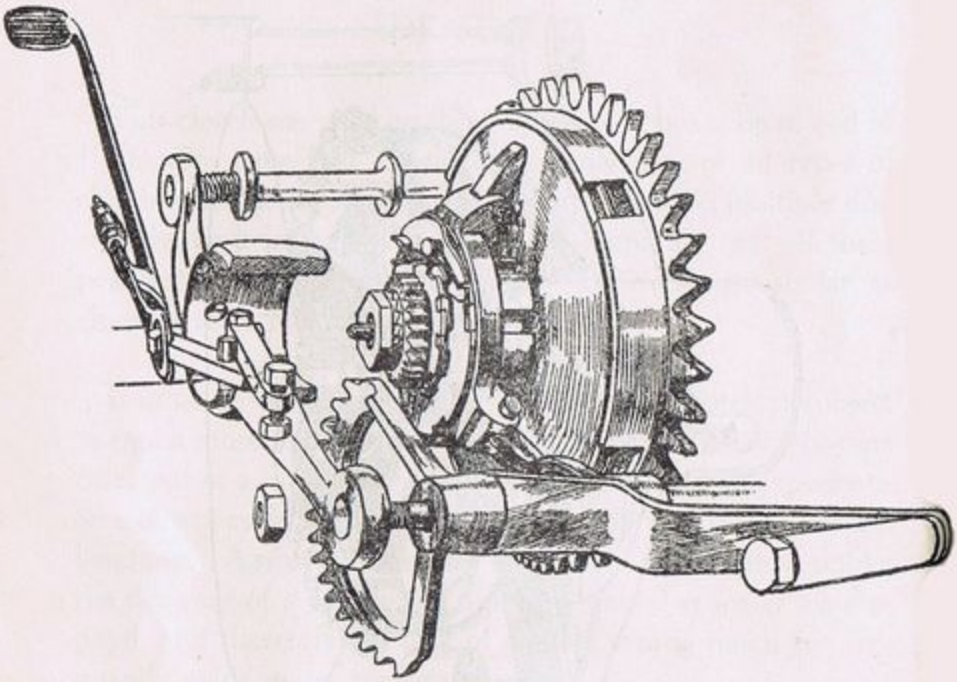
makes only a light spring necessary. It may be adjusted in less time than it takes to read this sentence, without the use of any tools.



Sectional view of the Patent Plate Clutch as fitted to 1920-23 Models.

With the exception of the pivots on the operating mechanism, it will run a season or more without lubrication of any description. It may be dismantled and assembled in a very few minutes, and it embodies in its construction all the good points of other clutches, with their doubtful ones eliminated. It is quite possible, but not advisable, to start on top gear on any

gradient within the power of the engine, yet when it is driving it is absolutely positive in action, and it takes up its drive as sweetly as any clutch operating in an oil bath.



General view of the Clutch Assembly. This shows foot control, but our lightweight model has hand control.

Like all mechanical appliances it is liable to need small adjustments from time to time; these are quite simple and may be carried out by the ordinary rider, no matter how limited may be his mechanical knowledge.

Clutch Slip under load may be due to various causes :—

1.—Too light a spring pressure.

2.—Surplus grease from the gear-box flooding the plates.

3.—Paraffin used for cleaning, saturating the plates.

4.—Ferodo plates worn out.

On new machines as plates take up, see that there is clearance between the operating lever and the hardened actuating plunger.

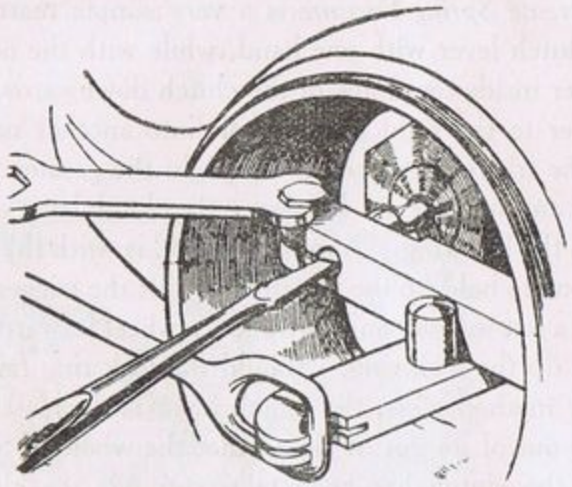
To Increase Spring Pressure is a very simple matter. Hold up the clutch lever with one hand, while with the other move the trigger inside the dome of the clutch downwards, and turn the trigger to the right until it falls into another notch ; the farther the trigger is turned to the right the greater the spring pressure, and *vice versa*. Releasing the clutch lever automatically locks the lock ring. Another method is, with the assistance of someone to hold up the clutch lever, lift the trigger out of its slot with a screwdriver and turn the fly-wheel forwards, thereby screwing up the lock ring. Should the lock ring fail to move by either method when the clutch lever is depressed and the trigger is out of its slot, it shows that the whole of the adjustment of the clutch has been taken up. If the clutch then persists in slipping, you should inject a pumpful or two of petrol to clear the grease or the paraffin out of the plates, and should the clutch still slip, it shows that the Ferodo plates have worn.

It may not always be necessary to fit a complete new set of plates, and frequently when a clutch slips it is possible to cure it by inserting a new plate immediately between the chain wheel and the first metal plate, as this prevents the radius in the chain wheel coming into contact with the radius in the first metal plate, as shown in sketch.

ADJUSTING CONTROL MECHANISM..

When adjusting the clutch it is advisable to adjust the control mechanism, although not absolutely essential. To tell whether the control mechanism should be adjusted, after using the clutch, start the engine up, and hold the clutch lever out to its limit. Should the clutch drag badly, it is a sign that the clutch operating mechanism is not depressing the spring sufficiently. To take up this slackness, undo the nut on the operating lever,

and screw up the adjusting screw pressing on the plunger lubricate the operating mechanism freely from time to time also the bearing in which the kickstarter ratchet works.



Adjusting the control mechanism.

Insufficient movement on the actuating plunger may be remedied this way.

CLUTCH DRAG.

Should the clutch drag badly after a considerable mileage it may be due to a groove being worn in the ball race preventing the clutch from freeing, and the obvious remedy is to replace with a new race. Should the clutch drag when new, it is evidently adjusted too tightly, or the clutch has been fitted to too close a limit, preventing the chain wheel from slipping on its ball races.

When assembling the clutch, it is imperative that plenty of grease be placed between the convex face of the lock-nut and the concave face of the ring carrying the three radial levers. The three radial levers should always move freely on their points, otherwise, should one lever be stiff, it will tilt the whole of the plates and prevent the clutch from gripping. Should the dome of the clutch wobble, this should not be taken as an

indication that the clutch is out of truth, as the former is only a dust cover, and pushed on the periphery of the chain wheel ring; it may be trued by pushing on in its correct position.

DISMANTLING THE CLUTCH.

To dismantle the clutch, depress the clutch lever and the trigger on the lock-nut, and unscrew the lock-nut off the centre boss as far as possible; then proceed to remove the operating lever bracket; when the two nuts are taken off, the arm can be drawn off, carrying the control levers with it; care should be taken to prevent the kickstarter lever flying round and hitting one's arm. The dome cover can be removed, and it will then be found that the ring carrying the radial levers is quite free, and by pulling hard towards you the ring will slip off the boss, bringing the three levers with it. It is unnecessary to remove the pins on which these levers work, as the clutch may again be assembled with the levers mounted on the ring. When the lock-nut and radial levers have been removed, the centre bearing through which the plunger works may be unscrewed (left-hand thread) as the removal of the levers immediately decreases the spring pressure. With this centre nut removed, the plates may be slid off the bosses, and it will be found that a single row of balls is carried in the centre of the chain wheel.

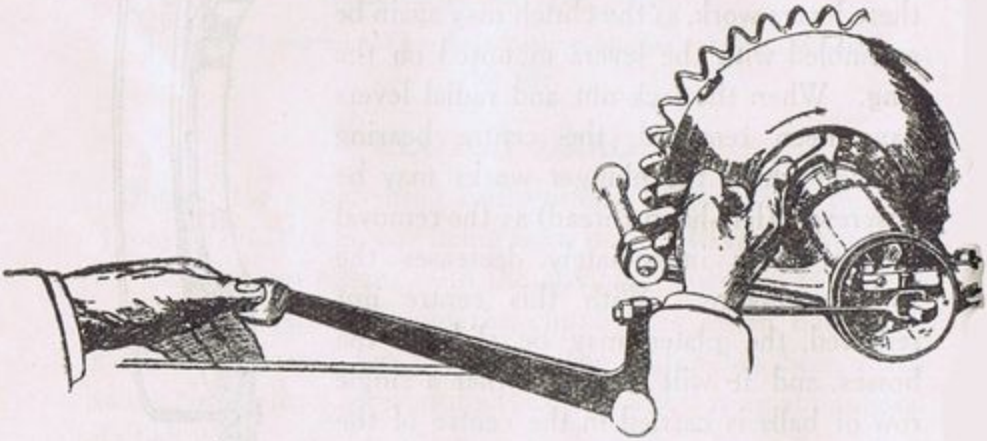
If the first metal plate comes in contact with the radius in the chain wheel a new Ferodo ring should be inserted.

To remove the boss on which the clutch is carried from the gear-box shaft, it will be necessary to unscrew the nut with a box spanner (left-hand thread). It should be borne in mind that it is very necessary when replacing the clutch to screw this nut home

exceedingly tight ; in fact, it may be hammered into position. To replace the clutch levers is a simple operation, but it may appear difficult to return the balls in their correct position. The simplest method is to replace the balls in the radius of the race with heavy vaseline ; after the plates have been slid into position, insert the spring, then the disc on which the plunger operates, and the centre nut through which the plunger works, When these are lightly in their place, insert a screwdriver in one of the slots on the main boss, and push the disc in front of the spring backwards and insert one of the radial levers ; repeat the operation and insert a second lever, and then a third when it will be found they readily spring into their place. Finally, thread on the lock-nut and adjust as previously shown.

IMPORTANT POINTS.

By incorporating these radial levers it is well to note that the initial spring pressure is multiplied by three ; therefore,



Method of adjusting the Clutch Spring Pressure. The operation may be done by hand in a few seconds. The arrow indicates the movement necessary to tighten the spring.

This illustrates the foot control, but the operation is the same with hand control.

50 lbs. on the plunger gives 150 lbs. on the outside diameters of the plates, which is the correct position to apply the pressure.

It should also be remembered when adjusting the clutch that a third of a turn on the adjusting check nut is equal to a full turn in the ordinary way for the same reason.

Should the Ferodo plates be greasy, they may be cleaned by wiping with petrol and burning off ; when dry, the surface should be brushed clean. The plates will be in no way harmed ; but under no consideration should cork inset plates be treated in this way.

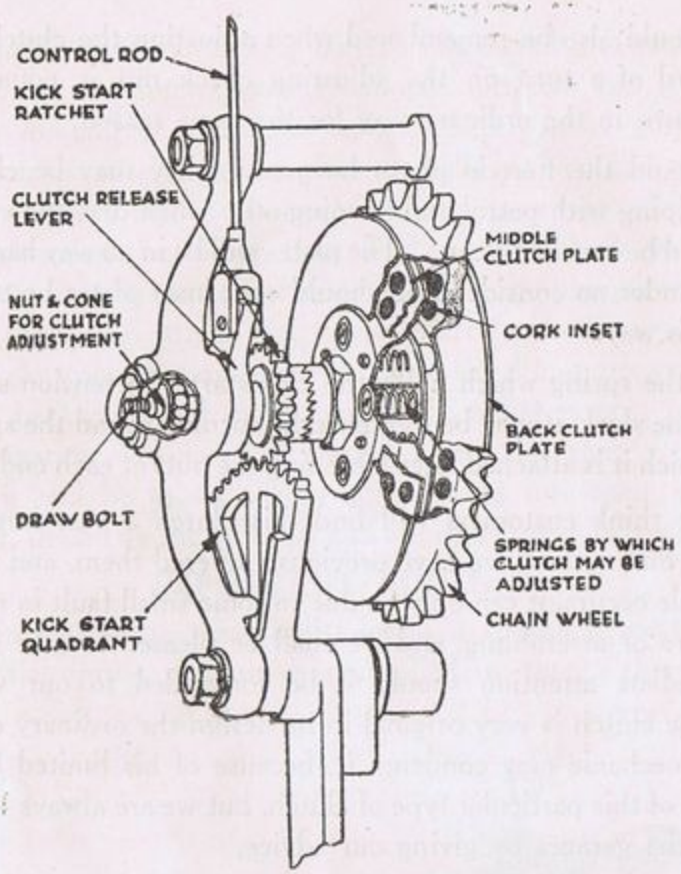
If the spring which holds the kick-starter in tension should become slack, it may be tightened by turning round the spindle to which it is attached after loosening the nuts at each end.

We think customers will find this clutch a vast improvement on anything we have previously offered them, and if any trouble occurs, it can only be due to some small fault in manufacture or assembling, and we shall be pleased to give it our immediate attention should it be forwarded to our works. As the clutch is very original in its design the ordinary everyday mechanic may condemn it, because of his limited knowledge of this particular type of clutch, but we are always willing to assist garages by giving our advice.

THE CORK INSET CLUTCH.

This type had many advantages over the previous cone clutches. It was not affected by temperature, rain, dust or grit. Its only foe was oil, which could be easily cleaned away by injecting petrol. It was absolutely free when withdrawn and took up the drive very sweetly, yet it was quite positive in action.

It had the disadvantage of being liable to burn out the corks when used carelessly. Slipping, which is quite reasonable on our later dry plate clutches, should be avoided whenever possible with the cork inset, and it was for this reason only that it has given way to the 1920 Dry Plate Clutch.



EXPLAINED.

The Douglas Cork Inset Clutch consists in all of five plates. On both faces of two of these plates are carried forty-four cork insets; the innermost of the inset plates is integral with the chain wheel, and thus is driven direct by the engine. On an extension of the chain wheel periphery an internal dog is cut, which drives and carries the second inset plate, but interposed will be found a plain friction plate which is mounted together with the back and front friction plates on an extension of the screwed sleeve gear pinion and is free to rotate independently of the inset plates. These latter plates are mounted on four radial ball bearings carried by the back friction plate, and

thus the inset plates are free to revolve independently of the friction plates. The cover or front friction plate also acts as a tension plate, as it carries the housing of the front tension springs, which in their turn register with the centre and back friction plates.

ADJUSTMENT FOR LOAD.

In the latter plate are carried four studs, on the threads of which screw the adjusting nuts that compress the springs, thus providing a method by which the tension may be regulated according to the load.

A hollow-slotted lock-nut secures the clutch bodily to the screwed sleeve gear pinion by a left-hand thread. Through this hollow lock-nut the clutch release draw-bolt operates a key that registers with the inner face of the cover friction plate in such a manner that when the draw-bolt is slid to the left the cover friction plate, through the medium of the previously mentioned key, compresses the tension springs towards the spring adjusting nuts, and so in this way the whole of the spring tension is relieved from the plates and a free engine results. Now, to slide the draw-bolt to and fro, some kind of leverage must be employed, and it is interesting to follow the method of operation. It has already been stated that the squared head of the draw-bolt is housed in the releasing key, and now it will be noticed by the accompanying illustration, the left extremity is threaded to receive a small cone running on ball bearings, while the cup for these is housed internally and machined intregral with the boss that carries an operating arm.

The boss of the operating arm is also machined externally with a quick thread, thus forming the male portion, which registers with a similar female quick thread cut internally in the centre of the supporting bracket.

Now if the operating arm is moved rearwards, a certain amount of lateral movement is also obtained, and as the

operating arm, houses in its extension, the cup of the thrust bearing, it also permits the cone and draw-bolt to follow this rightward movement.

This latter frees the releasing key, which permits the springs to exert their pressure, and so the plates, now being forced together, take the drive by friction.

By reversing the movement, that is, allowing the operating arm to travel forward, and thus obtaining the movement to the left of all the operating mechanism. the thrust is taken by the small ball bearing, and the movement conveyed *via* the draw-bolt to the releasing key.

This in its turn compresses the springs, and the plates, thus relieved of all friction, permit the engine to revolve without conveying the motion of the rear wheel.

ADJUSTMENT AND CARE OF THE INSET CLUTCH.

In the ordinary course of riding this clutch should go through a season without any attention from the rider. On the other hand, should the clutch be abused, it may require frequent adjustment, but no serious damage is likely to result to this clutch however harsh the treatment. Clutch slip is the trouble most frequently encountered. A sure sign of slipping is by the clutch becoming warm whilst driving. The cause of slip is generally oil on the plates, which is easily and quickly cleared by simply injecting petrol.

Another cause of slip is the clutch release draw-bolt may prevent the cover friction plate from properly bedding on the cork insets. To remedy this, remove the small dust cap screwed on the centre of the bracket, slacken back the small hexagon lock-nut, and then unscrew the cone until the clutch pedal may be moved half-way forward, before commencing to release the clutch. Finally, secure the lock-nut and replace the dust cap.

Still another cause of slip is insufficient tension on the four clutch springs. The obvious remedy is to screw up equally the four slotted nuts in the cover plate until the desired tension is obtained.

It is as well to remember that oil or any other type of lubricant is unnecessary for this type of clutch. It has been designed to run dry. Cork insets can be refitted at almost any workshop in case of emergency, but whenever time permits, a much more satisfactory way is to forward the clutch to our works.

If draw bolts give trouble this is a sign that the pedal has not been kept adjusted and the undue strain placed on the bolt has caused it to fail.

If this has been attended to carefully and the draw-bolt will not stand up to the work, examine the alignment of the Kick Start bolt and the front bolt supporting the outside bracket. If either bolt is bent it must be straightened or renewed.

After considerable use if either ball race of the main shaft is worn, or wear has taken place between the main shaft and screwed sleeve, this will allow the clutch to rock too much, and by straining the draw-bolt will cause it to break. In this case a new ball race or screwed sleeve will put matters right and prevent further trouble.

TO REMOVE A BROKEN DRAW-BOLT.

(Refer to 2¾ H.P. Spares List for the reference Nos. of the parts.)

Undo the dust cap (879 D) on the clutch release arm (871 D.). Remove the two nuts of the bolts supporting this arm and draw the latter off together with the K.S. Quadrant. Take off nut (893 D) from end of chain wheel sleeve nut (868 D), releasing the washer, spring and ratchet pinion (890 D). Use the valve cap spanner to undo ratchet nut (889 D), which has a left-hand thread.

If this nut fails to move, but the whole chain wheel sleeve turns, unscrew this for two turns only. The four slotted spring compression nuts can then be unscrewed, the clutch plates drawn off, and if the back plate is given a tap with a hammer it will come off easily.

The chain wheel sleeve nut must then be removed and the draw-bolt can be extracted from the back of it.

This operation must be reversed to fit a new bolt.

CARE OF THE CONE 1912-1914 CLUTCH.

This clutch, of which there are many still in use giving good service, is so large that it is rare to find it giving trouble by sliping.

If it does slip, hold it out by forward pressure of the clutch pedal, and wash out the clutch and clutch case with petrol. After the clutch is dry a trial run should be made, and it may be found that the slipping is cured. A little Fullers' earth may also be spread on the face of the clutch with the point of a thin knife.

If the clutch still persists in slipping, slacken the screw on the end of the cap which covers the spring of the clutch by, say, one or at most two turns. In order to do this the lock-nut will first have to be loosened. After adjusting the screw care should be taken to tighten up the lock-nut. Again make a trial run.

Care should be taken to keep the lock-nut of this screw absolutely tight.

If the clutch still slips, this probably indicates that the spring requires tightening. Take off the clutch cap by undoing the three screws that attach it to the clutch, and tighten the clutch-spring by screwing up the large nut which holds it in compression. Several turns may be given to this nut. If necessary an extra washer may be inserted. Again make a trial run.

If slipping continues, note whether the surface of the clutch is very dry and polished. If so, a little castor oil may be spread on it by means of a small camel-hair brush or with the fingers.

If none of these expedients cure slipping, it will only be because the material of the clutch is worn out. In this event the clutch will require to be taken out and sent to us to be refaced. With fair treatment, however, the surface of the clutch should not require renewal until the machine has travelled some 5,000 or 6,000 miles.

If the clutch should be too fierce, a very little powdered graphite may be spread on its surface by means of a thin knife.

If the clutch-spring is removed, it will be necessary to compress it in a vice and tie it in position with two pieces of strong cord before it can be re-fitted.

POSSIBLE CAUSES OF UNSATISFACTORY RUNNING.

Over-Oiling of Engine.—This may cause sooting of sparking plugs, and fouling and sticking of valves. Drain crank-case by means of plug fitted below same. Take out sparking plugs and valves and clean with petrol.

If the engine is sluggish and has lost its vim, cleaning the valve stems and guides, with a set of new valve springs will generally restore its energy.

Sparking Plug Points.—Incorrectly adjusted or foul—clean plugs with petrol, and verify the gap at the points. This should be equal to the thickness of a post card ; use the gauge attached to the magneto spanner. The plug, insulator and points should be free from oil and carbon. The most satisfactory plug for Douglas engines is the heavy electrode single point type. Other plugs may cause the engine to overheat, or, in other words, "dry up," when running at any speed.

Magneto Contacts Pitted or Incorrectly Adjusted.—These should be cleaned with petrol to remove oil or grease, and, if found pitted, should be trimmed with fine emery cloth or a small file. The points, when breaking contact, should separate about half a millimetre (thickness of a post card). Use the gauge supplied in the tool kit. Examine the bell crank arm that carries the platinum point; this must operate freely. Frequently the small spindle of this arm binds in the small fibre bush, especially if the engine has been idle for some time or it has been exported to a different climate; the weather conditions affect the fibre greatly. This trouble is not serious, but it is often difficult to trace. The obvious remedy is to ease the spindle or bush. To do this, roll a slip of glass or emery paper round a matchstick, and insert in the bush, twisting to and fro until sufficiently eased out.

Stopped Petrol Pipe.—Clear with a piece of copper wire or blow through with tyre pump.

Stopped Petrol Tap.—Unscrew lower portion of tap, clean gauge and wipe round inside of tap to clean out rust water, which gradually accumulates. Do not push wire through the base of tap or gauze will be broken.

Choked Carburettor.—Raise the needle valve or depress the tickler. If petrol is reaching the float chamber it will spray through the air-hole in the lid. If this is in order the spraying jet should be examined. If the needle valve is agitated up and down the petrol should spray out of the jet. If this does not occur, it is evident that either the jet or the channel connecting spraying-chamber to float-chamber is obstructed. In the early Douglas carburettors these can be cleared with a piece of fine wire (such as a strand of Bowden cable) passed through the openings, which will be found closed by screws, one under the spraying jet, the other at the side of the float chamber. If the jet is obstructed, it will probably be best to

unscrew it and clean it thoroughly before replacing. The modern Amac carburettors, though of different design, may be cleaned in much the same way.

Leaking Valves.—If the valves have become pitted, and compression is poor, the engine will run weakly, and be slow at starting. The valves should be ground in about once every 1,000 miles.

Dirty Valve Guides.—If oil reaches the stem of either the exhaust or the inlet valve, it will tend to stick in the guide, and the valve will not close with sufficient rapidity. A loss of power in the engine may be cured by taking out the valves and giving them and the guides a thorough clean with paraffin.

Mysterious Loss of Power.—If one is satisfied that the engine is clean, the carburettor free from obstruction, and that the valves and plugs are in good order, a loss of power is almost certain to be due to incorrectly adjusted magneto points. These should be set to the gauge.

If the engine refuses to start or if it stops suddenly :—

Presuming that it is not the elementary reason, absence of petrol, or tap not turned on—

Test carburettor to see that jet is not choked.

Take out sparking plugs, and see whether plugs have sooted up or the central electrodes come loose so as to touch the opposite points.

Test spark to see that the magneto is working properly.

This is done by laying each plug, still connected to the magneto, on the cylinder, turning the engine over by pulling the fly-wheel or back wheel, and observing the spark jump across the points.

Make sure that current is not leaking through high tension cable or short-circuiting to some part of motor.

Examine carbon brushes. Perhaps one is broken.

Satisfy yourself that engine is sufficiently lubricated, and that neither pistons nor cranks have seized.

Examine valves.

Satisfy yourself, by turning the fly-wheel, that neither the valve tappets nor the valves have jammed in their guides.

Make certain that valve tappets are properly adjusted. A lock-nut may have slackened and allowed a tappet to work loose.

If noises appear to come from the crank-case, it is possible that something in it has broken, in which case the engine should be sent to the works.

Make sure that lubricator is working properly and that engine is sufficiently oiled.

If stoppage occurs during rain, thoroughly dry high-tension cables and sparking plugs; most likely the insulation of the front plug is wet.

Examine induction pipe union, and see that the washers are sound and making an air-tight joint; a little oil placed round the joint will indicate an air-leak when the engine is turned over smartly.

Loss of compression may be caused by slots in piston-rings coming into line.

Slackness of Bowden wire controlling magneto may result in contact breaker being retarded, though lever on handle-bar would appear to indicate that it is fully advanced.

IMPORTANT.

Before writing us, customers would greatly assist and simplify matters by carrying out the following systematic tests :—

Examine the carburettor jet and note whether a good supply of petrol flows when the float is agitated.

Remove the plugs and test the spark at the plug points by resting the body of the plug anywhere on the engine taking care the brass terminal or wire does not come in contact with any part of the machine. Now turn the engine with the aid of the kick-starter or by pulling the back wheel, when a healthy spark should result at the plug points.

Examine each valve tappet carefully, revolving the head with your fingers to see that, when the valve is fully closed, the tappet clears in every position.

NOTE THESE POINTS.

That a rider who habitually controls speed by raising the exhaust valve instead of using the throttle may bring petrol consumption as high as 40 miles per gallon.

That when the brake-block wears it should be filed and re-fitted so that it only touches the sides and not the bottom of the brake drum.

That the face of the rear brake-block requires cleaning as much as any other part of the machine, otherwise it tends to become glazed and to slip, rasp off the glaze with a file and finish off with a piece of rag soaked in petrol.

That the ordinary lamp on W.D. models (old pattern) should be fitted on the lamp bracket with plenty of clearance between it and the front fork and mudguard.

That it is desirable to clean out the petrol tank occasionally, paying special attention to the gauze filter.

LUBRICATING AND ADJUSTING FRONT FORKS.

Four turns of the grease gun every 500 miles should be given to each nipple on the front forks.

To take up side play in the fork shackles remove the grease caps, and slacken off the lock nuts on either side. Insert a square key into the end of the fork spindle and turn anti-clock wise until the play is nearly all taken up; both sides being drawn up at the same time, as the spindles are threaded in the right-hand fork side. Tighten the lock nuts, making sure that the amount of adjustment for the top and bottom links is the same.

THE MAGNETO:
HOW TO KEEP THE OLDER TYPES IN ORDER.

(For latest types refer to Makers' Handbook).

The various parts of this apparatus require no lubrication, especially the contact breaker, which is designed to work without oil. It is therefore necessary to prevent any oil from getting on to the contact breaker and its platinum points. After having run a considerable time the magneto should be thoroughly cleaned and the platinum points carefully examined. The contact breaker disc should likewise be cleaned from time to time. The magneto should not be taken to pieces, except as a last resort. Should this, however, be absolutely necessary, it should be carried out in the following manner: The machine should be detached and the two carbon holders taken out. *Place upon the pole-shoes a thick rectangular piece of soft iron, in order to prevent the interruption of the magnetic circuit, which would occur were the armature withdrawn without first placing a keeper between the pole-shoes, remove magneto end plates, after which the armature can be drawn out.*

After all the parts of the machine, especially the bearings and oil cups, have been carefully and thoroughly cleaned, the machine is again re-assembled in the opposite order to that adopted when taking it to pieces. *The piece of iron plate upon the pole-shoes must on no account be removed until the*

armature has been placed in position. When replacing the contact breaker disc it should be observed that its key engages accurately in the armature shaft.

The most delicate part of the magneto is the contact breaker. The contact breaker is coupled with the armature and rotates with the latter. For this purpose the rear armature spindle is bored out. The boss of the contact breaker disc fits into this bore of the spindle, and its position is determined by a key on the contact breaker disc and a keyway in the spindle. A movable contact lever is mounted on the contact breaker disc, one arm of which is pressed against the platinum contact of the contact piece by means of the contact breaker spring, whereas the other arm carries a fibre block. The contact piece is fastened to the contact breaker disc by means of an insulated screw, and is connected with the end of the primary winding by the screw. The latter at the same time fastens the complete contact breaker to the armature spindle.

The rear end plate of the magneto provides a bearing for the contact breaker cover. Inside this cover, which is of a circular shape, the steel cams are fitted. The contact breaker rotates inside the circular portion in such a manner that the fibre block of the contact lever glides over the surfaces of the steel cams, causing the platinum points to separate. As soon as the fibre block leaves the steel segments the contact lever moves back against the contact piece, so that the platinum screws are again in touch with each other and the primary circuit is closed since the contact lever is in contact with the beginning of the primary winding, through the contact breaker disc, armature spindle, and armature core, whereas the contact piece is in connection with the end of the primary winding. When the fibre piece again glides over the steel segments the contact lever is deflected and the primary circuit interrupted.

In order to ascertain if the contact breaker works correctly, move the flat spring aside, remove end cap and see if the fasten-

ing screw is well tightened up, also if the steel segments as well as the platinum screws are securely fastened. Further, see if the contact lever is resting on the contact piece when the fibre block of the contact lever has left the steel cams, and whether this lever while passing over the steel segments is deflected by the steel segments, when the distance between the platinum contact should be 0.4 mm. This gap can be regulated by means of the platinum screw. If this is in order and the platinum screws of the contact breaker require examination, the complete contact breaker must be removed. For this purpose carefully draw off the contact breaker cover, when the contact breaker will be completely exposed ; after removing the screw by means of the magneto spanner, withdraw the contact breaker carefully and ascertain if the platinum contacts are thoroughly clean. If necessary clean them carefully, and remove any oil or dirt ; also if they are uneven—but only then—file them flat by means of a fine file. If the platinum screws are badly worn so that even filing will not improve them, new platinum screws must be fitted. When replacing the contact breaker care must be taken that it comes into the correct position, which is determined by a key and keyway ; also when replacing the cover it is to be noted that the gap provided in the lever comes over the stop screw on the rear end plafe.

Special attention should be given to the contact breaker lever, as the pivot of same cannot easily be lubricated, it being carried on a fibre bush. On new magnetos it may occasionally happen that, owing to the swelling of this fibre bush, caused by variation of temperature, the contact lever becomes a fixture and so destroys the action of the contact breaker entirely. This can easily be rectified by slightly enlarging the bore of the fibre bush by means of a suitable reamer ; a small strip of emery or glass paper rolled around a match stick will serve the purpose.

The magneto belongs to the high tension class. The high tension current is generated in the winding of the armature itself without the assistance of any separate induction coil.

Between the pole-shoes of two strong steel magnets, which form a powerful magnetic field, rotates a shuttle armature. This generates an alternating current in the winding of the armature. The armature consists of two portions, one of which "the primary," consists of a few turns of heavy wire, whereas the other portion, "the secondary," consists of many turns of fine wire. The tension of the armature produced by the rotation of the latter is increased by the sudden interruption of the primary circuit at a suitable moment by the contact breaker. Such an interruption is effected twice in every turn of the armature, producing a high tension current in the secondary winding, which is conducted over the slip ring and terminals through the cables to the sparking plugs, on the motor, and then, jumping across the electrodes, forms an arc-like spark. The timing of the ignition can be varied on the magneto itself by means of a timing cover carrying steel segments for deflecting the contact breaker arm. This cover can be turned so that the interruption of the primary circuit occurs earlier or later. The timing cover permits of a variation of timing of 20° which, measured on a motor, gives 40°.

It must be particularly noticed that no oil gets on to the contact breaker, as the burning of such oil between the contacts will wear them much more rapidly, and, in addition, the oil being a non-conductor, a bad contact will result in the magneto working irregularly.

SAFETY SPARK GAP.

In order to protect the insulation of the armature and other current conducting parts against dangerous high voltage, a safety spark gap is provided. The high tension current discharges itself across this gap should the cables connected to the plugs become dislocated, or the distance between the

electrodes of the sparking plugs be too great (see also paragraph *re* locating faults). The discharge across the safety gap must, however, not continue for any length of time.

SUGGESTIONS REGARDING IRREGULARITIES IN THE IGNITION.

When irregularities occur in the ignition it is to be ascertained if the trouble is with the magneto itself or with the sparking plugs.

It is advisable to carry out the following instructions in such cases :—

Exchange the sparking plugs and examine the plug cables, in order to see whether the insulation of same is defective.

The difficulties are likely to be due to the plugs if only one cylinder works irregularly or does not give an explosion at all, whereas the other cylinder is in good order. To ascertain which cylinder is wrong, disconnect the cable leading to one cylinder and try to start the motor. If it starts, then the cylinder from which the cable has been disconnected is at fault. A new plug is probably necessary.

The troubles likely to occur with sparking plugs are :—

Short Circuiting at the points, caused by burnt oil bridging across the gap. Remove this.

Too Large a Gap between the points. The normal gap is 0.5 to 0.6 mm.; larger or smaller gaps are not favourable for the ignition. The correct gap can be set with the gauge on the magneto spanner; if they are too far apart the sparks will jump across the safety gap, and the gas in the cylinder will not be ignited. If the plug is removed from the cylinders the sparks will jump across even if the distance between the electrodes is too great, so that such a test will not show whether the plugs are adjusted correctly or not. The reason for this is that an electric spark will jump a much wider gap in air than it will under compression.

Sooting up of the Plug. If this should occur, the points can easily be cleaned by washing the plug in petrol.

If the Ignition fails suddenly a short circuit caused by the cable connected to the plug may be the trouble. By removing this cable completely from the plug the fault can quickly be located. If ignition cannot be obtained now, then the cable itself is shortening, and the insulation of same should be examined. If, however, after removing the cable from the plug no ignition is obtainable, or if the ignition in itself works regularly, then the trouble will be in the magneto. This may be caused by the unsatisfactory operation of the contact breaker.

TYPES OF MAGNETO.

Bosch, E.I.C., Thomson Bennett and C.A.V. Magnetos are the principal types fitted to Douglas machines in the past. The E.I.C. is the present fitting. The instructions on previous pages are applicable, generally, to any of these magnetos, but it is advisable to apply to the makers for a booklet on the particular type fitted.

DOUGLAS DIXIE MAGNETO.

The two types of Douglas Dixie Magneto have been fitted on models of some years ago; their chief characteristics are identical, and they differ only in the different pattern of breaker box, one having a flat spring breaker bar in which no lubrication of the breaker lever is required.

Whether timing lever is at retard or advance position, the spark is of the same strength for any given speed.

Briefly, it differs from the orthodox magneto as the breaker is stationary. The points are not only out of the reach of oil, but are readily accessible for adjustment by removing breaker box cover.

No wire on any of the revolving parts.

A simple field coil housed in the arch of the magneto away from oil and grease.

No change in polarity takes place in the rotating member. Change of polarity takes place only through the field pieces, which assures the minimum loss of energy.

The high tension current is generated in the winding of the field coil, without the use of a special induction coil.

The screw securing the magneto wheel on "Dixie" Magnetos has a left hand thread.

CARE OF THE DOUGLAS DIXIE MAGNETO.

Facilities for oiling are provided for by an oil cup on the breaker end of plate, and ten drops of light oil every 500 miles are sufficient.

The breaker should be lubricated with a few drops of light oil every 500 miles. N.B.—This does not apply to Dixie magnetos with flat spring breaker bar—no lubricating on these models is necessary.

The proper distance between the platinum points when separated should be .020 or .015 of an inch.

When the trouble is difficult to locate it is as well to examine carefully for cracks, which are directly responsible for short circuits, in the secondary distributor brush holder. This holder will be found housed internally, but these remarks apply as well to both the collector or high tension brush holders.

TO REMOVE TYRES.

Tyres are fitted so that the side to be detached first is on the flywheel side of the machine.

If the front tyre has to be repaired, the front stand should be used, when it will be found considerably easier to effect the repair. Put up the back stand first and then the front, otherwise the front stand may become damaged.

The engine should not be run with the front stand in use, nor is this stand strong enough to bear the weight of the rider.

By using the levers supplied in the tool kit, removal and replacing of tyres becomes a very simple process. Be careful the tube is partly inflated before replacing a cover; otherwise there is a danger of the tube being nipped between cover and rim.

In dealing with a bad puncture or burst in the back tyre, it will probably be found best to remove the wheel before attempting to repair.

Note.—ON MODELS WITH BELT DRIVE.

If the front wheel has been removed, in refitting, see that the left hand cup locking ring is on the left-hand side, otherwise the cup will unscrew and probably cause a serious accident.

(See the illustration of the hub page 89.)

REMEMBER.

That you have a cycle as well as an engine.

To lubricate wheels and fork spring pivots.

To lubricate into two-speed gear in models "U," "V," "W," "X," "T/S," S/W and C/W.

To lubricate countershaft, chain, pedal bracket, and pedal bearings (in model "T").

To go over the nuts of the whole machine occasionally.

To drain crank-case and wash out with paraffin occasionally.

To carry a pump and repair outfit.

That the face of the cone clutch should not be oiled and that paraffin must not be used to clean the Ferodo plate clutch.

GENERAL.

To keep the engine always efficient, it should be taken apart, and the piston heads and the interior of the combustion chambers cleaned from carbon deposit at least once every 3,000 miles. It is also desirable that the piston rings should occasionally be taken off and the grooves thoroughly cleaned from carbon deposit. The rings may be removed by inserting under each three slips of tin, say, $\frac{1}{4}$-in. × 2-in., which will enable the rings to be passed over the grooves.

Over-lubrication is the cause of carbon deposit, and attention to the lubrication arrangements will repay itself by the engine remaining clean for a much longer period.

Use Wakefield's Castrol X.L. Oil or Price's Huile de Luxe or Mobiloil T.T.

THINGS WORTH KNOWING.

The sprocket wheel is attached to the fly-wheel by a left-hand thread; the pull of the engine locks it sufficiently without the aid of any other locking device.

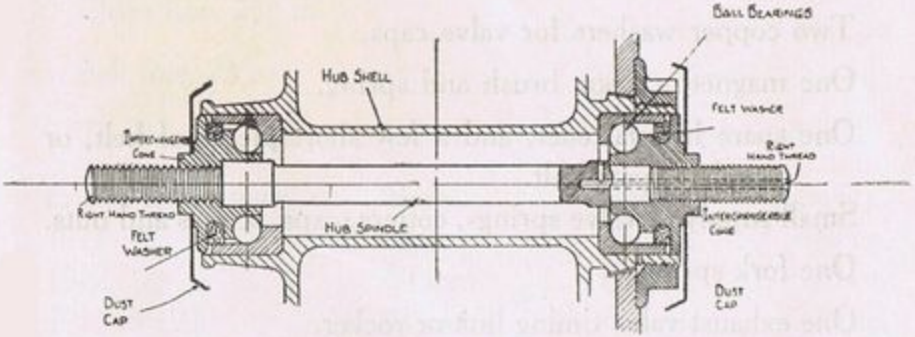
The sprocket wheels of Douglas engines are inter-changeable, except in the case of the fly-wheel clutch.

The latest type of front forks as fitted since 1919 are not inter-changeable with the W.D. models of previous dates, as the steering column has been made larger in diameter.

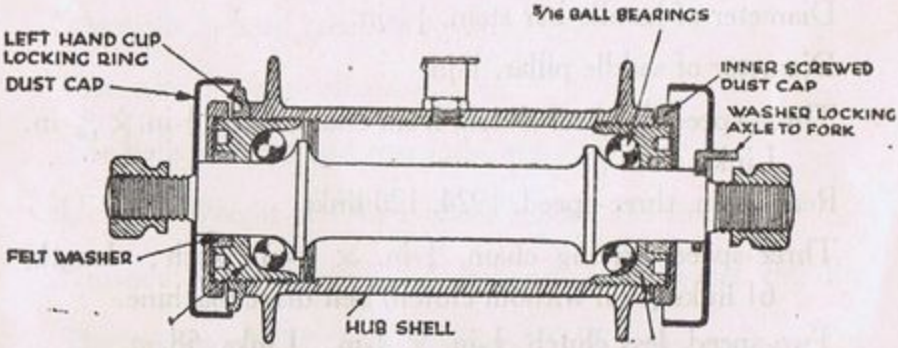
Distance pieces may be obtained to vary the chain lines of 1915 and 1916 models to suit earlier machines.

To lower or raise the handle-bars, unscrew the expander bolt situated in the centre of the handle-bar lug two or three turns, and tap with a spanner; next loosen the usual head clip bolt, when the bars may be lowered or raised.

1920-1923 Models are fitted with $\frac{1}{4}'' \times \frac{5}{8}''$ chains and chain wheels. The S/W and C/W Models have $\frac{1}{2}'' \times \frac{3}{16}''$ chains.



The C.W. Douglas Hub as fitted to All-Chain Drive Models.



The Douglas Dust, Waterproof, Oil Retaining Hub as fitted to Chain Cum Belt Drive Models.

SPARES FOR TOURING.

The following spares are recommended for touring :—

Two valves complete—one inlet and one exhaust valve.

Two spark plugs and washers.

Two copper washers for valve caps.

One magneto carbon brush and spring.

One spare belt fastener, and a few short pieces of belt, or complete spare belt.

Small supply of valve springs, cotters, caps, screws and nuts.

One fork spring.

One exhaust valve timing link or rocker.

One chain from engine to countershaft; spare link and spring clip for both chains.

SOME USEFUL DATA.

Diameter of handle-bar stem, $\frac{15}{16}$-in.

Diameter of saddle pillar, 1-in.

Three-speed flywheel clutch, front chain, 1924, $\frac{1}{2}$-in. $\times \frac{3}{16}$-in. Links, 78.

Rear chain, three-speed, 1924, 120 links.

Three-speed driving chain, $\frac{1}{4}$-in. $\times \frac{5}{8}$-in. pitch; length, 61 links (60 if without clutch) belt drive machine.

Two-speed, less clutch, $\frac{1}{4}$-in. $\times \frac{5}{8}$-in. Links. 58,

Two-speed, with clutch, 1924, $\frac{1}{2}$-in. $\times \frac{3}{16}$-in. Links, 74.

Belt, $\frac{3}{4}$-in.; length, 6 ft. 6 in.

Wheel-base, 4 ft. $7\frac{1}{2}$ in.

Overall length, 7 ft. 1 in.

Height of saddle pillar lug, 28 in.

Weight of C.W. Model, 198 lbs.

Weight, clutch model, 1920-21, belt driven, unladen (for licence purposes), 196 lbs.

Same model, 1920, without clutch, 195 lbs.

Two speed model, 1921, 185 lbs.

Chain line, $2\frac{5}{8}\frac{5}{4}$ in.

Belt line, $2\frac{1}{2}$ in.

Tank holds nearly $1\frac{1}{4}$ gallons of petrol and 3 pints of oil.

Engine Dimensions.	Bore.	Stroke.	Capacity.
1911	$2\frac{3}{8}$ in. ..	60 mm. ..	340 cc.
1912	60 mm. ..	60 mm. ..	340 cc.
1913 to 1920 ..	61 mm. ..	60 mm. ..	349 cc.
1920 to 1925 ..	60.8 mm. ..	60 mm. ..	348 cc.

Crank-shafts for models of 1913 or later date will not fit to earlier models unless the crank-case is machined out in certain parts.

The balls in head race are $\frac{3}{16}$-in.

The balls in clutch ring are $\frac{3}{16}$-in.

The balls in front and rear hubs are $\frac{5}{16}$-in.

Unladen Weight of 1923 2-speed model, 175 lbs.

Unladen Weight of 1923 3-speed and clutch model, 196 lbs.

The tax on all $2\frac{3}{4}$ T/S, S/W and C/W, equipped as they leave the works, is 30/-.

REPAIRS.

Repairs will be executed at the Works, Kingswood, Bristol, at the lowest cost consistent with material and skilled workmanship, and every care taken to ensure satisfaction.

All goods sent us for repair will be examined and an estimate submitted for approval, if desired, before the work is commenced. Should this estimate not be considered satisfactory, we are always willing to revise, or modify it as far as possible to customers' requirements, but if any essential parts are omitted, cannot guarantee the repairs (see end of book), as we do if the original estimate is accepted.

All repairs should be sent to us carriage paid (otherwise we cannot accept delivery) with the fullest instructions as to requirements.

If the engine or any consignment is sent to us for repair or adjustment it should be enclosed in a very strong wooden box with ample packing of shavings or newspapers around it. The label on the box should distinctly state the name and address of the sender of the consignment.

If a complete motor cycle is sent, it should, if possible, be placed in a crate, otherwise it may be damaged in transit. The name and address of the sender should be stated on the label attached to the crate. All fittings, such as inflator, horn, lamp, tools, speedometer, etc., should be removed before the machine is despatched.

PERSONAL,

We are anxious that every rider of a Douglas Motor Bicycle should be entirely satisfied with his machine. Every effort on our part will be made to give satisfaction.

Should the rider experience any difficulty with one of our machines, he need feel no hesitation in communicating with us.

We are interested, at all times, in the opinions and experiences of Douglas riders, and we welcome reasonable and friendly criticism.

SPARE PARTS.

IMPORTANT NOTICE.

Our department for the supply of Spare Parts forms an important part of the establishment. It is our intention that goods shall be sent away by the first post after receipt of the order.

We think it right to mention that we have suffered considerable loss through customers not paying for goods forwarded to them. What frequently happens is that we receive a letter or wire stating that certain parts are urgently needed. Rather than cause a delay by asking for a remittance, we have forwarded the goods with an invoice, relying on the honour of our customer to send the money. In many cases we found that our confidence was misplaced, and accordingly have been obliged to alter our practice.

In future, no spare parts will be issued until they have been paid for. When a customer is ordering by letter, he may either remit the exact amount (as prices frequently alter, a preliminary enquiry as to cost is advisable), adding postage, or he may remit such sum as he thinks likely to cover the cost. If the amount remitted is in excess or insufficient, our despatch clerk will make the necessary adjustment. When cash is not sent with the order, we shall at once issue an advance invoice, and when the amount is remitted the goods will be instantly dispatched. If the goods are urgently needed, a remittance may be sent by wire. In any case we shall henceforth be unable to depart from our rule of not dispatching spare parts until payment for same has been received.

It is with reluctance that we have taken this step, as we know that it will sometimes cause inconvenience to genuinely

honest but thoughtless persons. *Where, however, inconvenience is anticipated, we would recommend our clients to open with us a small credit account.* A deposit of, say, £3 will cover the cost of many spare parts, and will save the customer all inconvenience. If this is done, it is desirable that when ordering goods one should specify "Deposit A/c." A statement of the account will be rendered periodically.

When deposit-account customers order goods by wire, the word "Deposit" should be written at the end of the telegram, and if wiring away from home, the name of the town in which they reside must follow the word "Deposit." This is necessary to enable us to identify the A/c, and to avoid delay in despatching goods from stock.

A telegraph money order should be accompanied by the name and address of the sender. The Post Office do not give this unless it is paid for in the private message.

Please give the Engine Number with each order for spare parts.

When returning parts for replacement, it is essential that the number of the engine should be quoted, as the matter cannot be dealt with unless this information is received.

A Spare Parts List forms the subject of a separate book.

When returning parts for free replacements under the Guarantee, the test card and all other particulars asked for on page 103 must be given.

Guarantee.

We give the following guarantee with our motor cycles instead of the guarantee implied by statute, or otherwise, as to the quality or fitness of such machines for the purpose of motor cycling; any such implied guarantee being in all cases excluded. In the case of machines which have been used for "hiring out" purposes, or from which our Trade Mark or manufacturing number has been removed, no guarantee of any kind is given, or is to be implied.

WE GUARANTEE, subject to the conditions mentioned below, that all precautions which are usual and reasonable have been taken by us to secure excellence of material and workmanship; but this guarantee is to extend and be in force for three months only from the date of purchase, and damages for which we make ourselves responsible under this guarantee are limited to the replacement of any part which may have proved defective.

WE UNDERTAKE, subject to the conditions mentioned below, to make good at any time within three months any defects in these respects. As motor cycles are easily liable to derangement by neglect or misuse, this guarantee does not apply to defects caused by wear-and-tear, misuse or neglect.

The term "misuse" shall include amongst others the following acts:—

I.—The attaching of a side-car to the motor cycle in such a manner as to cause damage, or calculated to render the latter unsafe when ridden.

II.—The use of a motor cycle, or of a motor cycle and side-car combined, when carrying more persons, or a greater weight, than that for which the machine was designed by the manufacturers.

Any motor cycle sent to us to be plated, enamelled, or repaired, whether the repairs are required for the purpose of making good the defect before referred to or otherwise, will be repaired upon the following conditions, i.e., we guarantee that all precautions which are usual and reasonable have been taken by us to secure excellence of material and workmanship, such guarantee to extend and be in force for three months only from the time such work shall have been executed, and this guarantee is in lieu and in exclusion of any common law or statute warranty, and the damages recoverable are limited to the cost of any further work which may be necessary to amend and make good the work found to be defective.

Conditions of Guarantee. If a defective part should be found in our motorcycles, or in any part replaced, it must be sent to us, carriage paid, and accompanied by an intimation from the sender that he desires to have it repaired free of charge under our guarantee, and he must also furnish us at the same time with the number of the machine, the name of the agent from whom he purchased, and the date of the purchase, or the date when the alleged defective part was replaced, as the case may be.

Failing compliance with the above, no notice will be taken of anything which may arrive, but such articles will lie here at the risk of the senders ; and this guarantee, and any implied guarantee, shall not be enforceable.

We guarantee only those machines which are bought either direct from us or from one of our duly authorised agents, and under no other conditions.

We do not guarantee the specialities of other firms, such as tyres, saddles, chains, lamps, etc., or of any component part supplied to the order of the purchaser differing from our standard specification, supplied with our motor cycles or otherwise.

The Term Agent is used in a complimentary sense only. and those firms whom we style our agents are not authorised to advertise, incur any debts, or transact any business whatsoever on our account, other than the sale of goods which they may purchase from us ; nor are they authorised to give any warranty or make any representation on our behalf other than those contained in the above guarantee.

Terms : Payment. Our terms are nett cash. Delivery : At our works. Orders should be accompanied by remittance. Cases are charged under cost, and are not returnable. Packing : free.

Conditions of Sale All Douglas Motor Cycles are sold under the guarantee and conditions mentioned on this page, and the specialities of other firms, such as tyres, belts, electrical fittings, etc., are outside our warranty.

DOUGLAS MOTORS LTD.

LUBRICATION SUMMARY.

Although also dealt with in other parts of this Book, we think that a Summary of the parts that require lubrication will prove useful for quick reference.

Oil Recommended :—

WAKEFIELD'S CASTROL X.L.

Grease Recommended :—

WAKEFIELD'S TRANSMISSION GREASE.

ENGINE.

Should receive three pumps full of oil when new, before starting. 1 pump full every 4 to 6 miles for first 500 to 600 miles. *Do not exceed 20 to 25 m.p.h. during this period.*

1 pump full every 8 to 12 miles when nicely "run in." The exact quantity required will vary according to road conditions, average speed, weight of rider, etc.

FLYWHEEL CLUTCH.

Should receive two turns of grease gun every 300 to 400 miles. Screw up hexagon adjustment nut before using Ewart's Gun, and readjust to original position when lubricant has been inserted.

FORK SPINDLES.

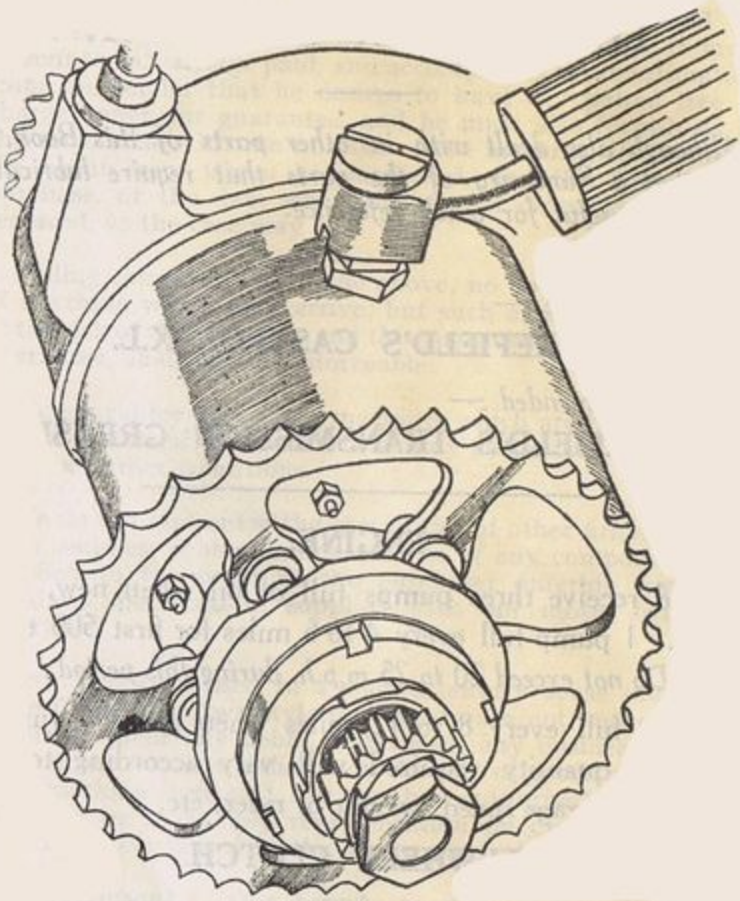
Should receive four turns of grease gun every 500 miles.

WHEEL HUB SPINDLES.

Should receive six turns of grease gun every 1,000 miles.

GEARBOX.

Should receive half grease gun of oil or of a mixture of oil and grease every 300 to 400 miles.



Showing method of attaching Grease Gun to Nipple.

CHAINS.

Should be taken off, cleaned with paraffin, and soaked in hot grease once every 1,000 miles, and more often in bad weather, if wear of chain and sprockets is to be avoided.

FRONT AND REAR BRAKES AND GEAR OPERATING RODS.

Should receive a drop of oil on every moving part, pin or bearing for lever, every 200 to 300 miles. All weather riders should clean off mud and dust every two or three days at these points, and after working oil into the joints, smear a coat of grease on the outside as an additional protection.

BOWDEN CONTROL WIRES.

Oil should be applied to the upper end of the wires, and worked well into the casing by raising and dropping the levers a few times. In the case of the carburettor and magneto control wires, expose the wire at the upper end by pulling the casing and moving the levers at the same time. Apply oil to the wire and work down the casing, finally applying a little grease, attend to this every 1,000 miles or oftener in bad weather.

HEAD LUG OR STEERING BALL RACES.

These are so designed that they are weather proof, and are packed with grease when assembled, so will not require attention until several thousand miles have been covered, *i.e.*, when it is time to dismantle the forks, examine the bearings. Pack the bearings with grease when re-assembling.